Printed on Thin Paper for Foreign Circulation.

Library

SEP 14 1921

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXII.—No. 3426] LONDON: FRIDAY EVENING, AUGUST 26, 1921 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO CONTRACTORS ONLY.

The Commissioners of H.M. Works, &c., are prepared to receive SEPARATE TENDERS before 11 a.m. on Friday, 16th September, 1921, for the SUPPLY of (a) ELECTRICAL and (b) MECHANICAL ENGINEERING LABOUR-IN-DAY-WORK in the Cardiff district.—Forms of Tender and all particulars may be obtained on application to the CONTRACTS BRANCH, H.M. OFFICE OF WORKS, King Charles-street, London, S.W. 1. 5064

Survey Draughtsman Required by the GOVERNMENT of NIGERIA for two tours, each of 12 to 18 months' service, with prospect of permanency. Salary £480 a year, rising by annual increments of £30 to £720 a year. Free single quarters and first-class passages. Liberal leave in England on full salary.

Candidates, under 35, preferably single, must possess a knowledge of lettering, plotting, co-ordinates, and map projection.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Nigeria 11,024. 5906

The Polytechnic, Regent Street, W. 1.

SCHOOL OF ENGINEERING.

President of School: The Hon Sir CHARLES PARSONS, K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.
Head of Department: HENRY J. SPOONER, M.I. Mech. E., M.I. Auto. E., A.M. Inst. C.E., F.G.S., &c.

The DAY DEPARTMENT RE-OPENS on SEPTEMBER 20th, 1921. Entrance Examination, September 13th, at 10 o'clock.

Three-year DIPLOMA COURSES in—
MECHANICAL ENGINEERING,
MOTOR CAR ENGINEERING,
ELECTRICAL ENGINEERING,
CIVIL ENGINEERING.

Practice in the Laboratories, Drawing-office, Workshop and Field.

Fee, 21 Guineas per annum.

The EVENING DEPARTMENT RE-OPENS on SEPTEMBER 26th, 1921. Students enrolled from September 14th, 6 to 8.30 p.m.

Detailed Prospectus of Day or Evening Department, 2d., post paid, from the DIRECTOR OF EDUCATION. 5970

University of Birmingham.

FACULTY OF SCIENCE.

ENGINEERING DEPARTMENTS.

I.—MECHANICAL ENGINEERING.

Chance Professor: F. W. BURSTALL, M.Sc., M.A. (Cantab), M. Inst. C.E., M. Inst. M.E.
Lecturer: R. C. FOSTER, M.Sc. (Vict.), A.M. Inst. C.E.
Demonstrator: S. J. ELLIS, A.M.I.C.E.
Lecturer on Machine Design: F. H. BODEN.
Assistant Lecturer on Machine Design: HENRY BAKER, B.Sc.

II.—CIVIL ENGINEERING.

Beale Professor: FREDERICK C. LEA, M.Sc., D.Sc. (Lond.), A.M.I.C.E., A.R.C.S.
Lecturers: R. C. PANTON, M.Sc.
R. E. STRADLING, B.Sc., A.M.I.C.E.
H. W. COULTAS, B.Sc.
Lecturer on Town Planning: W. HAYWOOD.

III.—ELECTRICAL ENGINEERING.

Professor: WILLIAM CRAMP, D.Sc.
Lecturer: E. J. KIPPS, M.Sc., M. Inst. E.E.
Assistant Lecturers and Demonstrators: O. R. RANDALL, B.Sc.
H. VICKERS, M.Eng.
G. M. HARVEY, B.Eng.

The FULL COURSES EXTEND OVER FOUR YEARS, and Students who enter after Matriculation and pass successfully the Examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE in Engineering.

The SESSION 1921-22 COMMENCES on OCTOBER 3rd, 1921.

For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the SECRETARY. 5715

University of Birmingham.

DEPARTMENT OF METALLURGY.

Professor: THOMAS TURNER, M.Sc., A.R.S.M., F.I.C.
Lecturer: DOUGLAS H. INGALL, M.Sc.
Assistant Lecturers and Demonstrators: T. G. BAMFORD, M.Sc.
HAROLD HARRIS, B.Sc.

The course of study covers three years and leads to the Degree of B.Sc. in Metallurgy. There are separate courses for Metallurgists and Metallurgical Chemists. Special attention is devoted to Iron and Steel, Copper, Brass, and Local Industries, and to Preparation for Colonial and Foreign Posts.

Research and other Scholarships.

For particulars apply to

GEO. H. MORLEY, Secretary.
5776

Metropolitan Water Board.

TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY AT LITTLETON, MIDDLESEX.

The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of PUMPING MACHINERY at Littleton, Middlesex, having a maximum capacity of 300 million gallons per 24 hours against a head of 46ft.

Forms of Tender, conditions of contract, specification and drawing may be inspected without payment of fee at the offices of the Board, Room 173, Chief Engineer's Department, Rosebery-avenue, Clerkenwell, E.C. 1, on and after Friday, 26th August, 1921.

Contractors desirous of tendering may obtain the necessary documents from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £3 3s., which sum must be deposited with the Board's Accountant and will be returned on receipt of a bona fide Tender, together with all incidental papers.

Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Thursdays and Saturdays excepted).

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1," and endorsed "Tender for Machinery, Littleton," must be delivered at the offices of the Board not later than 10 a.m. on Wednesday, 16th November, 1921.

The Board do not bind themselves to accept the lowest or any Tender.

W. MOON, Clerk to the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1
15th August, 1921 5935

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Airship Disaster.

Effect of Appendages on Ship Resistance.

Lift-Locks on a Belgian Canal.

Water Power Developments in North Wales.

Notes on Trevithick's Locomotives.

Developments in Power Station Design. No VI.

Elongation and Gauge Length in Tensile Tests.

200 H.P. Uniflow Steam Engine.

Battery Vehicles.

Vacuum Pump for Corrosive Gases.

PUBLIC NOTICES

University of Bristol.

ASSISTANT LECTURER in ENGINEERING, £300-£350.

For particulars and form of application send stamped, addressed, foolscap envelope to the REGISTRAR, Merchant Venturers' College. 5977

University of Glasgow.

JAMES WATT CHAIRS IN THE DEPARTMENT OF ENGINEERING.

The University Court will, during the course of the University term beginning 1st October, 1921, proceed to the APPOINTMENT of a JAMES WATT PROFESSOR of ELECTRICAL ENGINEERING and a JAMES WATT PROFESSOR of the THEORY and PRACTICE of HEAT ENGINES.

Information regarding the Chairs may be obtained on application to the SECRETARY of the UNIVERSITY COURT, University of Glasgow.

East Indian Railway.

The East Indian Railway Company is prepared to receive TENDERS for the SUPPLY and DELIVERY of :—

(1) GALVANISED CORRUGATED SHEETS.
(2) METALLIC FILAMENT LAMPS.
(3) STEEL FLAT-FOOTED and DOUBLE-HEADED RAILS.
(4) STEEL MATERIAL.
(5) WROUGHT IRON.
(6) PIG IRON.

As per specifications to be seen at the Company's offices.

Tenders are to be sent to the undersigned, marked "Tender for Galvanised Sheets," or as the case may be, not later than Eleven o'clock a.m. on Wednesday, the 7th day of September proximo.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By Order,
G. E. LILLIE, Secretary.

Nicholas-lane, London E.C. 4,
24th August, 1921. 6009

City of Nottingham.

APPLICATIONS are INVITED for the following TEMPORARY ASSISTANTS in the City Engineer's Department. The engagement (if services are satisfactory) will be for 12 months certain.

(a) STEEL DRAUGHTSMAN. Salary £400 per annum. Candidates must be thoroughly qualified in the Design of Constructional Steel Work, more particularly such as is required in connection with the Erection of Large Power Stations, &c., and similar buildings.
(b) TWO ENGINEERING ASSISTANTS. Salary £400 per annum. Candidates must have had large and varied experience in the Design of important Engineering Buildings, such as Power Stations, &c.

Applications for the above appointments will be considered only on forms, which may be obtained from the City Engineer, Guildhall, Burton-street, Nottingham, and must be sent to him, together with copies of three recent testimonials, in an envelope endorsed "Steel Draughtsman" or "Engineering Assistant," on or before 5th September, 1921.

Canvassing members of the Council is prohibited, and will be a disqualification.

W. J. BOARD, Town Clerk.

Guildhall, Nottingham,
20th August, 1921. 5972

SITUATIONS OPEN

CENTRAL HEATING AND DOMESTIC ENGINEERING.—REPRESENTATIVE REQUIRED for London and South, with good connection among architects. Commission and expenses.—Write, with all particulars, to Manager, Heating Dept., The WELL FIRE AND FOUNDEY CO., Ltd., 15, Berners-st., W. 1. P3893 A

COMPETENT ELECTRICAL ENGINEER REQUIRED for large E.H.T. Power Station in the East, to Take Charge (under superintendent) of entire Maintenance of Switchgear, Alternators, &c. Liberal salary and allowances. Three years' agreement. Single man preferred, age not over 35.—Address, 5990, The Engineer Office. 5990 A

EXPERT and Experienced SALESMAN WANTED by old-established firm of Steel Manufacturers, with practical knowledge of Automobile and Tool Steels. State experience and terms, &c.—Address, 6000, The Engineer Office. 6000 A

MESSRS. CHARLES ROBERTS and CO., Ltd., Railway Wagon and Wheel and Spring Works, Horbury Junction, near Wakefield, REQUIRE the SERVICES of a thoroughly competent and energetic MAN to Take Charge of their Forge, Drop Stamp Department, and Smithy, which department is fully equipped with the latest appliances. Only those men who have had a thorough training in this class of work need apply.

Application should be made in the first case, by letter only, stating age, experience, and salary required, addressed to the MANAGING DIRECTOR. P3913 A

OIL MILL ENGINEER.—
OIL MILLERS OFFER progressive POSITION to ENGINEER possessing highest technical qualifications, executive ability, and works experience gained in responsible position.

The mills are extensive, equipped with modern machinery and every device for efficiency.

The power and steam are generated by the most up-to-date plant to enable maximum economy to be obtained. Intimate knowledge of modern heavy duty Conveying Plant is necessary.

The position is one for a man 35-40 years of age with wide experience, strong personality, tact, energy, initiative, and capability of handling men and plant to the best possible advantage.

Full details, age, experience, references, &c., and salary required.

Address, P3897, The Engineer Office. P3897 A

REPRESENTATIVE WANTED, with Real Live connection among Collieries (one technically acquainted with Colliery Plant), for old-established company in the Midlands; liberal terms.—Address, 5824, The Engineer Office. 5824 A

REQUIRED by the London Co-operative Society, a CHIEF ENGINEER, with practical experience of Bakery, Laundry, Dairy and Refrigerating Machinery. Must also be acquainted with the running of Electric Petrol and Steam Motor Vans.

Applications, endorsed "Engineer," to be made by letter, stating age, salary, and experience, and addressed to the GENERAL COMMITTEE, 54, Maryland-street, Stratford, London, E. 15. 5099 A

WANTED by a London Firm, a HEATING and VENTILATING DRAUGHTSMAN.—State age, experience, and salary required to Box No. E. 1535, c/o Dawson's, 121, Cannon-street, E.C. 4. 5997 A

DRAUGHTSMAN WANTED, Up-to-date in Colliery Plant, Yorkshire district; only those giving fullest particulars, age and references entertained. No waisters need apply.—Address, 5823, The Engineer Office. 5823 A

SITUATIONS OPEN (continued)

FOREMAN MOULDER WANTED for the Loam Moulding Section of Large Ironfoundry. Applicants must have had first-class experience in this class of moulding, and only those who have held similar position elsewhere will be considered. The position is a permanency to a suitable man.—Apply, in writing, stating age, experience, and salary required, 5987, The Engineer Office. 5987 A

FOREMAN MOULDER REQUIRED, to Take Control of Large Plate and Machine Moulding Shop of Ironfoundry. Applications are invited from men who have specialised on moulding machines and can prove their ability to turn out large quantities of repetition work on an economical basis. State age, experience, positions already held, and salary required.—Address, 5988, The Engineer Office. 5988 A

GENERAL FOREMAN, East Midlands, with All-round experience of Machines, Smiths', Assembling and Erecting Pumping Machinery, including Steam Engines, Air Compressors and General Contractors' Plant; quick in dealing with breakdowns and repairs.—Address, 5913, The Engineer Office. 5913 A

GENERAL FOREMAN MOULDER WANTED to Take Charge of Large Ironfoundry making castings up to 30 tons weight, comprising green and dry sand, loam moulding and core making. Applicants must have held similar positions of responsibility, be used to the successful control of men, and have good knowledge of up-to-date foundry practice, including piecework systems. Applications, which will be treated in confidence, should state age, experience (in full), approximate salary required, and be accompanied by copies of recent testimonials.—Address, 5986, The Engineer Office. 5986 A

COMPETENT TURNER (Both Light and Heavy work) REQUIRED for Gold Mine, West Africa.—Address, giving particulars of experience and salary required, with copies of testimonials, 5962, The Engineer Office. 5962 A

BOILERMAKER.—LEADING PLATER WANTED by Midland Firm making vertical boilers and pipe making. Practical experience in the working of Hydraulic and Pneumatic Machinery, &c., essential. Good permanent job. State age, experience, and wages required.—Address, 5944, The Engineer Office. 5944 A

ESTIMATING CLERK WANTED: Must be Accustomed to Hydraulic and Oil Mill Machinery.—Apply, giving full particulars of experience and stating salary required, to ROBT. MIDDLETON and CO., Sheepscar Foundry, Leeds. 5991 A

REQUIRED, ESTIMATING CLERK for Engineering Works, turning out various repetition parts. Only those with the necessary experience to enable them to prepare reliable estimates and accustomed to modern methods need apply. Fullest particulars, in strictest confidence, and salary.—Address, P3898, The Engineer Office. P3898 A

SITUATIONS WANTED

WANTED, a SITUATION as ASSISTANT to Consulting, Surveying, or Works Engineer. Age 28; 1st class B.O.T. cert.; energy and initiative; excellent refs.—J. F. SMAIL, 47, Beechwood-avenue, Streatham, S.W. 16. P3885 B

A.M.I.C.E., with Many Years' Experience, DESIRES APPOINTMENT or PARTNERSHIP, or engagement with view to same, with firm practising in waterworks or sewerage and sewage disposal. Please send replies, which will be treated as confidential.—Address, P3889, The Engineer Office. P3889 B

BUYER to MANUFACTURING ENGINEERS Will be OPEN to ACCEPT NEW APPOINTMENT end of August. Has had very wide experience as manager of large department. Keen organiser and administrator.—Write, Z. Y. 292, c/o Deacon's, Leadenhall-street, London. 5940 B

DIE-CASTING.—An EXPERT in DESIGNING and Making of all Classes of Dies, with first-rate experience of production in aluminium, zinc base, &c., by compressed air, plunger and gravity methods, good organiser and designer of new D.C. machine, SEEKS POSITION.—Address, P3870, The Engineer Office. P3870 B

SITUATIONS WANTED (continued) Page II.

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.

(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity. All communications to Head Offices,
H. W. REID, 95, Belgrave-road,
General Secretary. Victoria, S.W. 1.
EX.

SITUATIONS WANTED Page II.

MACHINERY, &c., WANTED Page II.

FOR SALE Pages II. and IV.

AUCTIONS, Pages III. and XCVI.

PREMISES TO LET OR WANTED Page II.

WORK WANTED, Page III.

AGENCIES, Page II.

MISCELLANEOUS, Page II.

For Advertisement Rates See Page 219, col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page XCIX.

SITUATIONS WANTED (continued)

ENGINEER, A.M.I. Mech. E., London, R QUIRES REPRESENTATIVE AGENCY, or CON ' LTING WORK. Sound experience in hydraulic, chemical, and oil installations, factory lay-out and general engineering.—Address, 6008, The Engineer Office. 6008 B

ENGINEER (24), B.Sc. (Eng., Lond.), 4 Years' apprenticeship railway workshops, footplate and drawing-office and 1 year steam wagon works, REQUIRES POST. Hard working and energetic; first-class testimonials to character and ability.—Address, P3882, The Engineer Office. P3882 B

ENGINEER DESIRES POSITION; 15 Years' works manager's reference, ex-Captain Royal Engineers, fully experienced home and American, all branches, including steam, motor, maintenance, constructing, erecting machinery, &c.; good commercial knowledge; proficient in handling labour; would go abroad; languages, good knowledge Hindustani and Spanish.—BURNS, 21, West Ashton-street, Salford, Manchester. P3904 B

ENGINEER.—EX-OFFICER R.E., 35, 1st class Board of Trade, 10 years sea, 3½ years river craft, experience with refrigeration, electric light, water-tube boilers, oil fuel, SEEKS POSITION, home or abroad.—C/o WICKHAM, Newsagent, Lenham. P3895 B

ENGINEER (27), 1st B.O.T. Certificate, Expert draughtsman, thorough knowledge of ship and engine repair work and general engineering, has been assisting in management, REQUIRES RESPONSIBLE POSITION anywhere with prospects of advance.—Address, P3887, The Engineer Office. P3887 B

ENGINEER, with Croydon Office, WANTS to REPRESENT good FIRM; salaried appointment desired; district, South London and counties.—Address, P3901, The Engineer Office. P3901 B

ENGINEERING WORKS MANAGER. Full experience all branches engineering, including electrical, planning, lay-out, reconstruction, organisation and overhead efficiency.
Full particulars past results on application.—Address, 5828, The Engineer Office. 5828 B

EXECUTIVE ENGINEER (Civil), Possessing Good connections and 25 years' experience on public works construction, shortly OPEN to ENGAGEMENT. Railway, dock, and building experience, including Far East. Charge jobs. Willing to go abroad.—Address, P3907, The Engineer Office. P3907 B

INSPECTING ENGINEER DESIRES NEW CLIENTS. Thoroughly experienced rail, pipe and general engineering inspections. Large knowledge home and continental rail and other works, Belgium, Germany, Austria, &c. &c. PERSONAL inspections carried out at short notice. Excellent references. Demobilised R.E. officer, 3½ years' war service.
Address, P3912, The Engineer Office. P3912 B

MAINTENANCE ENGINEER (43) DESIRES POSITION, Charge of Factory Plant, Workshops, or Electric Power Plant; 4 years' chemical works experience.—A. C., 81, Castle Boulevard, Nottingham. P3906 B

MECHANICAL ENGINEER, A.M.I. Ae.-R., Age 31, 16 years works, D.O., administrative, DESIRES POSITION as Assist. Works Manager, Dept. Manager, or similar post, at home or abroad. Varied experience, general, I.C.E., and small parts production; patentee. Progressive position more important than high salary.—Address, P3900, The Engineer Office. P3900 B

MECHANICAL ENGINEER (35, Married), 19 Years gen. engineering and scientific instruments, works, D.O., estimating, costing, administrative, asst. wks. mang. last, OPEN for IMMED. ENGAG., any position with prospects; excellent refs; public school educ.; conscientious, not afraid of work.—Address, P3878, The Engineer Office. P3878 B

MECHANICAL ENGINEER REQUIRES POSITION where abilities would be appreciated; over 20 years' engineering experience, erection, running, and maintenance of engines, boilers, turbines, &c. Age 40; good refs.—Address, P3910, The Engineer Office P3910 B

M.I.MECH.E., 18 Years' Management of Works, production of accurate interchangeable work and general engineering, DESIRES responsible POSITION. Business experience and fluent French. Salary required £600 p.a.—Address, P3832, The Engineer Office. P3832 B

OIL ENGINES.—ENGINEER, Extensive Knowledge hot-bulb two and four-stroke, land, marine, also high-compression engines, REQUIRES POST, design, manufacture, maintenance, or sales, home or abroad. Salary about £250.—Address, P3905, The Engineer Office. P3905 B

QUALIFIED MECHANICAL ENGINEER (37), A.M.I. Mech. E., at present regularly employed, DESIRES NEW CONNECTION. Practical and commercial managerial experience, machine tools, constructional machinery, general engineering, costing, designing, import and export. Good organiser; would run London office.—Address, P3858, The Engineer Office. P3858 B

PRODUCER GAS EXPERT, Aged 43, REQUIRES highly responsible APPOINTMENT at home or abroad, where ingenuity and untiring efforts would be recognised. Author of important lectures on producer gas. Wide experience of I.C. engines. Latest machine shop practice and handling of men also thoroughly understood. Highest qualifications can be submitted.—Address, P3892, The Engineer Office. P3892 B

TEMPORARY ENGINEER OFFICER (MAJOR), terminating his military engagement, A.M.I.C.E., M.I.N.A., &c., is OPEN for CIVIL APPOINTMENT; some commercial knowledge; experienced inspecting engineer; no objection to going abroad. Full particulars on inquiry.—Address, P3828, The Engineer Office. P3828 B

TO CONTRACTORS, &c.—ENGINEER and AGENT REQUIRES an APPOINTMENT; 14 years' experience in charge river and waterworks, slipways, electric power-houses, reinforced concrete, steel-framed structures, and office buildings; also good experience designing.—Address, P3914, The Engineer Office. P3914 B

TO CONTRACTORS AND OTHERS.—CAPTAIN, late Royal Engineers, with extensive pre-war and post-war experience in charge of works, and has carried out several well-known jobs, including nine years' London experience, REQUIRES APPOINTMENT as Manager, Engineer, or Agent with a well-established company.—Address, P3915, The Engineer Office. P3915 B

UP to £50 PAID for APPOINTMENT by Mech. Engineer. Wide practical and two years' commercial experience. Held leading positions; age 33 years. Strict confidence.—Address, P3854, The Engineer Office. P3854 B

WORKS or TECHNICAL ENGINEER (28), Public school and university, SEEKS RE-ENGAGEMENT as MANAGER or ASSIST. Modern engineering methods, works management, commercial, estimating, oil fuel, D.O., &c., experience.—Address, P3877, The Engineer Office. P3877 B

SITUATIONS WANTED (continued)

YOUNG ENGINEER (22), M.Sc., DESIRES POSITION with Firm Building Oil Engines. Workshop experience, three years' experience in design and running of Diesel engines.—Address, P3888, The Engineer Office. P3888 B

YOUNG ENGINEER, Stud. I.C.E., 5½ Years' apprenticeship with Messrs. Vickers, general workshop and office experience, technical education in engineering subjects, DESIRES POSITION as ASSISTANT ENGINEER to Civil or Mechanical Engineer.—Address, P3883, The Engineer Office. P3883 B

YOUNG MAN (22), 7 Years' D.O. and Workshop experience in general engineering, well educated, good technical training, urgently REQUIRES POSITION; commercial side preferred; salary secondary importance to future prospects; very ambitious.—Address, P3909, The Engineer Office. P3909 B

DRAUGHTSMAN SEEKS POSITION in London; 17 years' experience, design, details and estimating, all classes of structural work.—Address, P3903, The Engineer Office. P3903 B

DRAUGHTSMAN (32), 12 Years' Experience, Steel-framed buildings and general constructional work, designing, detailing, and quantities. Immediate start. Salary arranged.—Address, P3908, The Engineer Office. P3908 B

ENGINEER and DRAUGHTSMAN OPEN to RE-ENGAGEMENT. Experience: internal combustion engines, producers, gasworks plant, conveyors, jig and tool design, general engineering.—Address, P3874, The Engineer Office. P3874 B

ENGINEERING DRAUGHTSMAN REQUIRES ENGAGEMENT, or can work at home; N.W. district; moderate terms; used to taking own dimensions of buildings, &c.—Address, P3880, The Engineer Office. P3880 B

YOUTH, Age 18, REQUIRES SITUATION as JUNIOR DRAUGHTSMAN.—M., 1, Blomfield-street, Bury St. Edmunds. P3879 B

FOREMAN FITTER and ERECTOR WANTS SITUATION; highest credentials; age 35 years; last job 9 years; semi-Diesel engines.—LONG, Millbanks, Newbury, Berks. P3833 B

EX N.C.O., Age 26 Years, Served Five Years in Army, previously 1st footman, latterly 1½ years as departmental foreman in gramophone factory, thoroughly well recommended, WISHES to OBTAIN EMPLOYMENT of any kind, preferably as LEADING HAND or SUPERVISOR in a Factory. Would entertain Club Stewardship or private service as single-handed Butler or Valet.—Apply, L. F. READ, 29, Vinery-road, Cambridge. P3886 B

SMITHY and FORGE FOREMAN; 12 Years Foreman, marine and general engineering, forging presses, heat treatment, fixing piecework prices, technical training, advanced methods, tactful.—Address, P3827, The Engineer Office. P3827 B

PATTERNMAKER (1st Class) SEEKS SITUATION at home or abroad. Excellent refs; single. Would invest if desired.—T. W., 154, Grundy-street, Poplar, E. 14. P3902 B

STEEL ERECTOR, 18 Years Outside Foreman for large Liverpool firm, DESIRES EMPLOYMENT, home or abroad, contract or otherwise; age 39.—Address, D. B., 97, Brooke Green, Hammersmith, W. 6. P3881 B

PARTNERSHIPS

ENGINEERING PARTNERSHIPS AND BUSINESSES.

Wheatley Kirk, Price & Co.

46, Watling Street, London, E.C. 4.

Established seventy years.

ENGINEER, Public School Man, Age 32, with Good practical and commercial experience at home and abroad, DESIRES a JUNIOR PARTNERSHIP in a sound progressive business; investment up to £4000. Must be open to fullest investigation; principals only.—Address, 5973, The Engineer Office. 5973 C

MECH. ENGINEER (28), Thorough Technical training, works and drawing-office experience, REQUIRES POST with investment in medium-sized firm. Partnership preferred.—Apply, HENRY, Solicit' Matlock. P3

SECRETARY DIRECTOR REQUIRED in London for sound old-establishe' company. Knowledge of engineering an advanta' investment £1000-3000. Salary £800 p.a. and dividends. Full investigation offered to prospective investors' solicitors and accountants.—Write, Box 1463, N.A.S., St. Ann's Chambers, Ludgate-hill, E.C. 4. 5989 C

EDUCATIONAL

CORRESPONDENCE COURSES for B.Sc., Inst.C.E., I. Mech. E., and all ENGINEERING EXAMINATIONS. Special Courses and Single Subjects. Personal Tuition.—Mr. TREVOR W. PHILLIPS, B.Sc. (Hons.), Assoc. M. Inst. C.E., M.R.S.I., &c., 8-10, Trafford Chambers, 58, South John-street, Liverpool. Ex

INST. C.E., Inst. Mech. E., B.Sc., and all ENGINEERING EXAMINATIONS.—Mr. G. P. KNOWLES, M.B.E., B.Sc., A.M. Inst. C.E., &c., personally PREPARES CANDIDATES, either orally or by correspondence. Hundreds of successes during the past twelve years. Courses can be commenced at any time.—99, Victoria-street, Westminster, S.W. Telephone No. Victoria 4780. Ex

FOR HIRE

FOR HIRE, PUMPS and WELL-BORING TOOLS for Contractors' Use, Wells, &c., 2in. to 24in. dia.—H. RICHARDS and CO., Upper Ground-street, London, S.E. Telephone No. 978 Hop. 822 c

AGENCIES

AGENT WANTED in Lincoln for the Sale of Bright-drawn Steel Bars and Bright Bolts and Nuts, on commission basis only.—Address, 5961, The Engineer Office. 5961 D

AGENTS WANTED by a London Engineering Firm of Iron and Steel Merchants representing well-known continental manufacturers. Preference will be given to applicants possessing connections among consulting engineers and users of gas by-product and chemical plants.—Address, A.G. 730, care Deacon's, Leadenhall-street, E.C. 5954 D

AGENCIES WANTED.—A LONDON FIRM, well in with exporters, railways, ironmongers, tool dealers, DESIRE a further AGENCY for any goods in hardware or engineering line. Have good knowledge of steels, springs and similar technical goods.—Address, 5897, The Engineer Office. 5897 D

ADVERTISER is OPEN to ACCEPT Good AGENCIES for Iron and Steel Works Plant, Engineering and Contractors' Plant, Machine Tools, &c., for Middlesbrough and Cleveland district. Old established with own office.—Address, 5922, The Engineer Office. 5922 D

AUSTRALIA.

MANUFACTURERS DESIRING CONNECTIONS and TRADE are invited to COMMUNICATE with FRANK R. PERROT, 354, Kent-street, Sydney, N.S.W., or 883, Hay-street, Perth, West Australia.
Cable Address:—Sydney, "Permorel;" Perth, "Lapwing." Ex.

ENGINEER, with London (City) Office, WISHES to REPRESENT or ACT as AGENT for any English or Continental firm of standing. First-class business reference.—Address, P3896, The Engineer Office. P3896 D

ENGINEER, with Offices at Newcastle-on-Tyne and excellent connection among colliery owners, engineering and shipbuilding firms in North Yorkshire, Durham and Northumberland, WISHES to TAKE UP AGENCY for well-established firm.—Address, P3890, The Engineer Office. P3890 D

GENERAL AGENT for Old-established First-class continental pump and valve manufacturers is PREPARED to APPOINT LOCAL SUB-AGENT in various centres. Live connection and previous experience are essential.—Address, 5968, The Engineer Office. 5968 D

MISCELLANEOUS

ENGINEER, with Good Offices Westminster, REQUIRES CONSULTING, REPRESENTATIVE or AGENCY WORK. Advertiser has held important posts number of years, home and abroad, for large concerns. Accustomed handling large contracts. Extensive experience marine, general mass production, engineering; thorough knowledge Continent. Many connections, engineering, shipping, steel works, registration societies, and commercial world, home and Continent. Speaks four languages fluently. First-class references from leading industrial men.—Write first instance, 5971, The Engineer Office. 5971 I

LIMITED COMPANY in Lancashire District, Having a patent short-stroke press, WISHES to GET into TOUCH with an enterprising ENGINEER who has thorough knowledge and good connection in Press-work, capable of Taking Full Charge in Exploiting same and Investing £3000-5000.—Address in first instance, giving details of experience, P3891, The Engineer Office. P3891 I

PATENTS, INVENTIONS, TRADE MARKS DESIGNS. Advice and handbook free.—KING'S PATENT AGENCY, Limited (B. T. King, Director), 146a, Queen Victoria-street, London. 35 years' refs. Tel., Central 682. 5909 I

PUMPS.—A VACANCY Occurs for a PART-TIME MAN to Introduce Designs and Business on commission basis for a cheap type of Diaphragm Pump.—Address, 5978, The Engineer Office. 5978 I

TRANSLATIONS (French and German). For Best work go to R. SWIF', 50, St. Bees-street, Moss Side, Manchester. Many years' experience in engineering trade. P3540 I

MACHINERY, &c., WANTED

WANTED, BLISS PRESS, No. 27, or No. 28 Knuckle or Toggle. Send full particulars, including age, condition, lowest price, and where can be inspected.—Address, 5985, The Engineer Office. 5985 F

WANTED, M.B.V. BRASS MELTING FURNACE, 200-400 lb. capacity. State age, where can be seen, and lowest price.—Address, 5917, The Engineer Office. 5917 F

WANTED, ONE 30ft. by 8ft. LANCASHIRE BOILER, complete with usual fittings, to re-insure for 160 lb. working pressure.—Address, 5958, The Engineer Office. 5958 F

WANTED, PLATE BENDING ROLLS, Suitable for plates up to 3-8in. thick by 8ft. long by 12in. dia. or near. Must be in good condition.—Address, 5706, The Engineer Office. 5706 F

WANTED, SCREW-CUTTING LATHE with 2ft. gap, 6ft. or 8ft. between centres, with chuck, hollow spindle, 9in. centre, for millwright work.—Reply, Messrs. SPICER, Navan, Ireland. 6007 F

WANTED, UNDERMENTIONED PLANT, in nearly new condition:—
ONE SET THREE-THROW HYDRAULIC PUMPS, pressure not less than 1800 lb. per sq. inch, capacity 15/30 galls. per minute; electrically or belt driven.
5 and 7 cwt. "Massey" PNEUMATIC HAMMERS, electrically or belt driven.
TWO 10 or 15-Ton OVERHEAD ELECTRIC CRANES, span 54ft. centres.
All above for use on 440 v., 50 cycles, 3-phase supply.
Apply, HENRY BALFOUR and CO., Ltd., Durie Foundry, Leven, Fife. 5841 F

WANTED, 15-TON SECOND-HAND OVERHEAD TRAVELLING CRANE, 48ft. 6in. span, capable of doing work from ground level.—Send full particulars to the Mining Dept., STAVELEY COAL and IRON CO., Ltd., Staveley Works, near Chesterfield. 5959 F

GUILLOTINE SHEARS WANTED, 18in. or 24in. blade for ¼in. plate; must be in first-class condition; De Bergue make preferred.—Address, 5983, The Engineer Office. 5983 F

SECOND-HAND MOTORS REQUIRED—

3 PHASE A.C. 415 volts, 50 Periods. Slip Ring and Short Circuiting Gear, Slide Rails and Pulley.

Must be in A1 condition, electrically and mechanically complete with oil immersed circuit breaker and starter.

H.P. of Motor.	No. Required.	Approximate Speed.
50	4	950 R.P.M.
25	55	700 "
15	1	700 "
5	6	950 "
7½	6	1100 "
3	6	1395—1500.
3—4	5	As offered.
2	6	"
1½—1	6	"

CABLE.
3 core Cable equal to 127/.103—300 yds.
4 core Cable " 61/.093—300 yds. } (or to make up to these lengths).
3 core Cable " 37/.093—150 yds.
4 miles Cable equal to 7/.064. | 1½ miles Cable equal to 3/.029. | 2 mile Cable equal to 7/.029.
Above must be 2800 megs. grade, and Insulation not perished in any degree.
Main Breakers. Suitable for above Cable required.
Distributing Boxes.
Also 1 Motor A.C. 415-Volts, 3 Phase, 50 Periods, "75—80 B.H.P., 180 R.P.M., with Starting Panel complete
Address, 5982, The Engineer Office. 5982 F

FOR SALE

A TIME RECORDER, as New, Guaranteed. Latest model. What offers?—A. F. PELLEY, 140, Farringdon-road, E.C. 1. Ex.

AIR COMPRESSORS FOR SALE.—
Powerful Horizontal Belt-driven Twin AIR COMPRESSOR, capacity 985 cubic feet.
ONE Horizontal Steam-driven AIR COMPRESSOR, by Larmuth, capacity 250 cubic feet.
TWO New Vertical AIR COMPRESSORS, complete with coupling and bed-plate, to carry motor, capacity of each 16 cubic feet free air per minute.
ONE "Worthington" Steam-driven AIR COMPRESSOR, capacity 51 cubic feet, new in 1915.
ONE Horizontal "Ingersoll" AIR COMPRESSOR, cylinder 8in. diameter.
ONE No. 8, Size 14b "Scotland" Vertical Compound Belt-driven AIR COMPRESSOR, capacity 150 cubic feet.
ONE Powerful Horizontal Steam-driven "Ingersoll" AIR COMPRESSOR, capacity 1130 cubic feet.
Also several other AIR COMPRESSORS of various capacities.
TWO "Eclipse" COMPRESSED AIR ROCK DRILLS, with swivelling bars and adjusted screw.
JOHN H. RIDDEL, LTD.,
40, ST. ENOCH-SQUARE,
GLASGOW. Ex.

CONDENSING PLANTS (TWO), Contraflo Surface Type, by Richardsons-Westgarth, capacity each 24,000 lb. steam per hour, condition absolutely as new. Edwards AIR PUMPS, Worthington CENTRIFUGAL CIRCULATING PUMPS or CONDENSER; would be separated if required; bargain price.—HARRY H. GARDAM and CO., Ltd., Staines. 5886 c

DIESEL ENGINES, Six-cylinder, Two and Four-stroke, 250, 1000, 1500 B.H.P. Excellent condition. DYNAMOS for above, 250 or 500 volts D.C. Immediate delivery and low price.
Also TWO 500 K.W. PARSONS TURBINE SETS, 230 or 500 volts D.C., with condenser and spare armature.
ELECTRICALLY DRIVEN AIR COMPRESSORS, 250 volts D.C., pressures 1500 to 3000 lb. per sq. inch.
JENNINGS, West Walls, Newcastle-on-Tyne. Ex.

EXCEPTIONAL OPPORTUNITY to PURCHASE RAW BRASS, HIGH-SPEED and CAST STEEL and MILD STEEL, all in bars; also SHEET COPPER FIBRE and MILD STEEL. A very large assortment of sizes, immediate delivery, at low prices. Can be inspected at any time by appointment.—Write, SMITH'S SURPLUS STORES DEPT., Central Works, Cricklewood, London, N.W. 5981 c

FOR IMMEDIATE DISPOSAL.—
ONE New Crossley GAS ENGINE, 8 E. 12, 54 B.H.P., complete with Air Compressor and Receiver, set of Pipes and Bolts.
ONE 40 H.P. MOTOR, by Fuller, single-phase 400 volts, 140 amps., 90 periods, 850 r.p.m., with Starter (second-hand).
WILLIAM SAINT, Ltd., Cambridge. 5369 c

FOR IMMEDIATE DISPOSAL.—ONE 75 H.P. National GAS ENGINE, hit-and-miss type; 105 H.P. Stockport SUCTION GAS PLANT; Kynoch GAS PLANT, symbol "1, 65 maximum B.H.P." and SUCTION PLANT; 1 K.C.C. DYNAMO, 230 volts, 227 amps., 545 r.p.m. All the above may be seen at work at any time.—AUBLEY, HARRY and CO., Peterborough. P3873 c

FOR IMMEDIATE SALE, SIX Almost New 60in. Water-driven HYDRO-EXTRACTORS, by Watson, Laidlaw and Co., Ltd. Low price to clear.—JOHN H. RIDDEL, Ltd., 40, St. Enoch-square, Glasgow. 5358 c

FOR SALE, a Selection of POWER PRESSES, TOOL-ROOM and CAPSTAN LATHES, MILLING and DRILLING MACHINES, and various SMALL TOOLS, all in practically new condition, at low prices to clear. Can be viewed at any time by appointment.—Write, SMITH'S SURPLUS STORES DEPT., Central Works, Cricklewood, London, N.W. 5980 c

FOR SALE, BOILER FEED PUMP, Weir Type, 16in. steam cyl., 12in. gun-metal water barrel by 16in. stroke; immediate delivery.—WILLIAMS, 37, Queen Victoria-street, London. 6004 c

FOR SALE, First Quality SECOND-HAND SLEEPERS; main line, uncreosoted; good for sidings, cart roads, &c.—E. H. NEAL and CO., 53, The Broadway, Ealing, W. 5. Telephone, Ealing 1764. 5357 c

FOR SALE, FOUR 12-Ton Rope-driven TRAVELLING CRANES, approximately 40ft. span, longitudinal traverse 170ft., cross traverse 90ft., hoist 25ft. per minute. Can be seen working at any time.
These cranes are guaranteed in good mechanical condition and are offered for sale owing to being replaced by electric cranes.
Apply to ERNEST NEWELL and CO., Ltd., Misterton, via Doncaster. 5926 c

FOR SALE, in First-class Condition, 50 B.H.P. National GAS ENGINE with 8 WATER TANKS, Belt-driving 40 K.W. GENERATOR, compound wound, 120 v.; also SWITCH PANEL. GAS PLANT, by National, consisting of producer and scrubber.—Apply, CHAUCER PRESS, Bungay, Suffolk. 5827 c

FOR SALE, ONE NEW "PRIESTMAN" CRANE GRAB DREDGER, "RE" Size, complete, ready for immediate delivery. At bargain price to clear.
Apply, E. H. NEAL and CO., Contractors' Engineers, 53, The Broadway, Ealing, London, W. 5. 'Phones, Ealing 1951 and 1764. Telegrams, "Snoslaen, Ealux, London." 5370 c

FOR SALE, ONE 45 B.H.P. "Grice" GAS ENGINE, cylinder 13in. by 23in. stroke, two fly-wheels, magneto ignition, very good order; can be seen working.—Address, P3850, The Engineer Office. P3850 c

FOR SALE, ONE 200 K.W. and ONE 100 K.W. ELECTRIC GENERATING SETS, Ballies Compound High-speed Engines (120 lb. S.P.) direct coupled to E.C.C. Dynamos, 220 v. D.C. Most modern plant, nearly new and in first-class condition. Can be seen under steam any time.—Apply, WOLVERHAMPTON CORRUGATED IRON CO., Ltd., Ellesmere Port, near Birkenhead. 5372 c

FOR SALE.—ONE 250 H.P. Sisson and E.C.C. GENERATOR; TWO 250 H.P. Ballies and Morcom and Mather and Platt GENERATING SETS. Plant in good order, now running; shortly to be disposed of.—Address, 5960, The Engineer Office. 5960 c

FOR SALE or HIRE, ELECTRIC MOTORS from 60 to 300 H.P.; PORTABLE STEAM ENGINES from 8 to 40 N.H.P.; STEAM BOILERS, CRANES, PUMPS, MACHINE TOOLS of every description; reasonable terms, immediate delivery.—J. T. WILLIAMS and SONS, 57, Queen Victoria-street, London, E.C. Tel., City 3698. Ex.

FOR SALE, THEODOLITES, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 538, High Holborn, W.C. (Opposite Gray's Inn-road).

FOR SALE, LEVELS, DRAWING INSTRUMENTS, SECOND-HAND. CLARKSON'S, 538, High Holborn, W.C. (Opposite Gray's Inn-road). Ex.

For continuation of For Sale Advertisements, see page iv.

The Effect of Appendages in Ship Resistance.

THE determination of the precise resistance of ships' hulls is still far from being a perfect art. By slow degrees exact knowledge of the elements of ship propulsion is gradually increasing, though the progress lags far behind improvements in the mechanical devices that facilitate the attainment of superior efficiencies. At one time, not so very long ago, the estimate of the power required to propel a given ship was largely a matter of guesswork. Even when this problem was solved by the use of models, the determination of propeller dimensions still contained a considerable element of uncertainty, and empirical formulæ were in general use until a very recent period. Nowadays, the major uncertainty lies in where to put the screws rather than in the screws themselves, but until the total resistance of the ship is determined, the selection of screw dimensions must always retain some degree of indefiniteness. It was only in 1904 that we first received any definite resistance data of the performances of a methodically varied series of model forms. It was only in 1908 that we received—again at the hands of Mr. R. E. Froude—the results of a systematic series of experiments on model screws which were applicable to purposes of design or analysis of trials. Mr. W. J. Luke's experiments on wake and hull efficiency were not available till 1910, and the Teddington Tank did not start work till twelve months later. The same period witnessed the introduction and development of the marine steam turbine, the use of oil fuel, and, later, the universal adoption of the geared turbine, which between them have revolutionised methods of propulsion and enormously extended experience of propulsion of actual ships, while much essential work still remains to be done in evaluating the very uncertainties to which the newer methods have given rise.

The large amount of research work which has been directed in recent years to the subject of the resistance of various types of ship forms has been almost entirely concerned, as far as published records are available, with the shape of the naked hull, and not with that of the additional resistance caused by the sundry large appendages and numerous minor excrescences that are inseparable from the actual vessel. The result has been that, to no small extent, the influence of the often very considerable augmentation of resistance due to their presence has been somewhat neglected. Results of tank trials of varied forms give the necessary information for calculating the power required for propelling a naked hull; they indicate precisely the effect of change of proportion, but between the slow-speed single-screw vessel and the fast liner or battleship the additional resistance caused by the appendages may vary from about 2 to about 20 per cent., and while the resistance of the naked hull is a measure of the excellence of the form for the speed and displacement, it is consequentiy, by so much less, a guide to the work which the propeller is required to overcome.

It is a comparatively simple matter, thanks to the Froude constant system of notation, to give for any set of lines a series of constants denoting resistance at various speeds, or for any methodical variation of the parent form a further series showing the influence of the alteration. But when it comes to the problem of appendages, the whole question of determining and defining their degree of resistance is one of considerable difficulty. The presentation of the results of trials made to assess their influence is not easily dealt with, and cannot in any case be given in constant form, except as part of the whole. The usual method adopted is to apply an appendage coefficient based on experience of model and full-size trials. Two factors enter into the matter and render it less easily handled than the ordinary resistance of the hull. First of all, there is the wide variation in extent of appendages, and in the details of their design. In the second place, it is difficult to ensure that the resistances of models of these items in the tank do accurately represent the amounts occasioned in the ship. They are much more difficult to reproduce with accuracy than is the form of the hull; the amounts to be measured are individually small, though their aggregate may be considerable, and there is a distinct tendency for small items such as these additional fittings to show resistances in excess of their actual value, owing largely to disproportionate frictional resistance.

The appendages generally consist of one or more of the following items:—

(*a*) Stern-frame aperture, rudder or rudders.
(*b*) Shafting bossing, tubes or/and A brackets.
(*c*) Bilge keels.
(*d*) Docking keels.
(*e*) Scoops and openings in hull, *e.g.*, for discharges and suctions below water; and in warships, such special excrescences as
(*f*) Torpedo tube or paravane fittings.

Unless of exaggerated dimensions, if well designed and fitted with due regard to the stream lines and properly stream-lined in themselves, none of these items individually should be the cause of serious resistance, but if badly arranged or carelessly modelled, the consequent drag may be of considerable amount, and in high-speed vessels these items demand careful attention. They are very difficult and expensive matters to alter if found to be at fault.

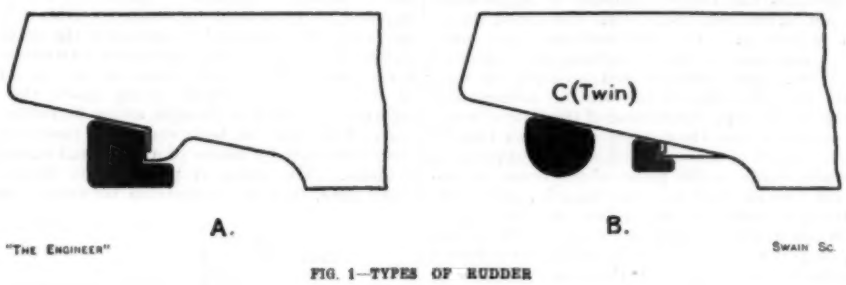


FIG. 1—TYPES OF RUDDER

For slow-speed single-screw vessels, the wake percentage is often so considerable, and eddy-making near the stern in full vessels of this type so prevalent, that the rudder resistance and even that due to the screw aperture is very small, and in any unbalanced rudder can hardly be more than frictional. When, however, the underhung type is adopted, particularly for twin rudders as fitted to the "Dreadnought" to "Queen Mary" series of ships, the additional resistance is an appreciable quantity, especially when, in addition to the massive rudder head required to withstand the heavy bending and twisting forces, the rudders are placed in the slip stream immediately behind the propellers. For the ordinary unbalanced rudder behind a full form, the extra resistance involved may be almost neglected. In any case, it is, practically, only frictional. The area is small and the speed at which it is moving through the water is low, being equal to $\frac{\text{speed of ship}}{1 + \text{wake factor}}$, and the latter term may easily amount to a figure of .30 to .45 or even more in cases of extreme fullness. The frictional coefficient to use for calculating the power absorbed in such cases is little, if any, more than that adopted for the hull itself, but in cases of underhung rudders, which are becoming usual in vessels with cruiser stems, and particularly in Channel steamers, where the advantage of such a form is very marked, the frictional coefficient requires to be taken as that due to the length of rudder. This, in itself, represents a distinct increase, but the intrusion of a large projection from the hull into the stream lines aft occasions considerable drag. In the case of a rudder as indicated in view A in Fig. 1, the upper portion is no more than an extension of the wetted surface of the hull, but in view B the additional resistance is no mean quantity. Tank trials to determine the amount of power absorbed tend to overrate the precise degree of resistance, but the following figures can be taken as representing the relative influence in the case of a battleship of post-Dreadnought design. With a naked hull resistance of 100, the additional resistances occasioned are approximately as follows:—For single centre line rudder (A), about 1.3 per cent.; for twin rudders on centre line (B), about 2.35 per cent.; for twin rudders side by side (C), about 7.0 per cent. Twin side-by-side rudders with their transverse centre lines slightly inclined inboard were generally adopted in all the British vessels of the "Dreadnought" era up to the "Royal Sovereign" class, in which two centre-line rudders were adopted. In the battle-cruisers built subsequently to the Queen Mary—Repulse, Courageous, Hood—the single centre-line type was re-introduced.

The most informative subdivision of appendage resistance which has been published in recent times is contained in the very interesting paper read by Mr. S. V. Goodall, R.C.N.C., at the last meeting of the Institution of Naval Architects, wherein a comparison was given between that of H.M.S. Royal Sovereign and that of the ex-German battleship Baden, as the result of experiments in the Haslar Tank. The relative resistance of the various items is expressed as a percentage of the resistance of the naked ship at a speed of 20 knots:—

	Baden.	Royal Sovereign.
Naked hull	100	100
Bilge keels	2.9	7.6
Docking keels	2.2	5.5
Rudders	3.5	1.5
Shaft bossing and brackets	7.2	2.9
Bow torpedo tube and discharges aft	1.9	—
	117.7	117.5

On account of her finer form, the docking keels of the Royal Sovereign are of considerably greater longitudinal extent than those of Baden. In the latter ship they form no appendage at all in the fore body. The difference in resistance due to bilge keels is explained by the much greater surface, 5370 square feet, in Royal Sovereign compared with 2500 in Baden. The twin rudders, shaft bossing, and struts of Baden necessarily involve greater resistance than the single rudder and shaft brackets of Royal Sovereign. This additional resistance of 17.5 per cent. apparently fell to about 13.8 per cent. at 22.3 knots, and at 25 knots in Royal Sovereign it was taken as 11.75 per cent. Information on this detailed subdivision of appendage resistance is very scarce.

The diagram given in Fig. 2 is taken from a paper on "The Problem of the Hull and its Screw Propellers," read by Rear-Admiral C. W. Dyson, U.S.N., to the Society of Naval Architects and Marine Engineers in New York in November last. Admiral Dyson states that the curves are rough approximations which he prepared from reports of trials in the model tank at Washington; approximate, because it is realised that the actual appendage resistance varies with the form of hull and the amount of power carried by the hull, and also with the revolutions at which the propellers are to run, these latter two factors fixing the size of shafting, external lengths of shafting and size of propeller struts. The curves—given in Fig. 2—represent percentage of appendage resistance to that of bare hull under the following circumstances:—

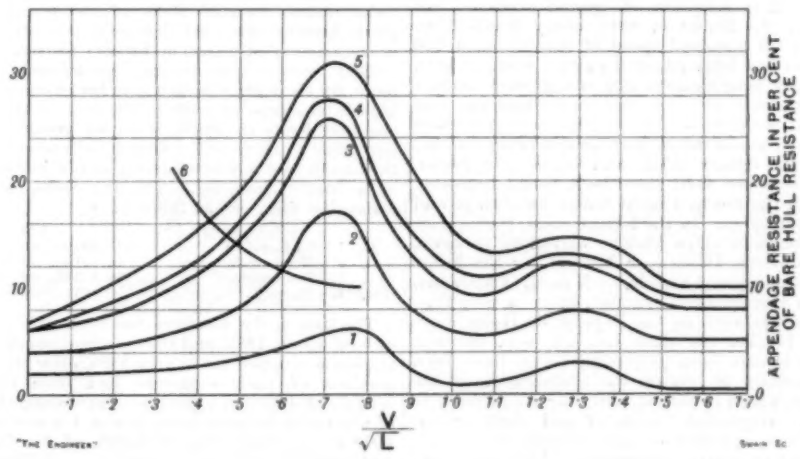


FIG. 2

Curve 1.—Bilge keels and rudder.

Curve 2.—Two shafts, bilge keels, after struts and rudder.

Curve 3.—Four shafts, bilge keels, docking keels, four struts and rudder; or two shafts, bilge keels, docking keels, aft struts and rudder.

Curve 4.—Axis of struts in shaft line, two shafts, four struts, bilge and docking keels and rudder.

Curve 5.—As in 4, but strut axis in line of motion.

All the above are for vessels with cruiser sterns.

Curve 6.—Ordinary stern, two shafts, one strut per shaft, bilge keels.

For torpedo-boat destroyers, the upper portion of Curve 3, between $\frac{V}{\sqrt{L}}$ 0.9 to 1.7 is intended to apply.

From the information published by the United

States Navy Department of its warship trials, the appendage coefficient, by which the resistance of the bare hull is to be augmented to give the total resistance, has the following values for various classes :—

	Knots.	Appendage coefficient.
For "Dreadnought" type battleships, including "Delaware," "Utah," "Wyoming," "Texas" and "Oklahoma" classes	At 21.0 ..	1.15 to 1.168
"Connecticut" class	„ 18.5 ..	1.171
Idaho and Mississippi (pre-Dreadnoughts, sold to Greece)	„ 17.0 ..	1.213
"Washington" class cruisers	„ 22.5 ..	1.152
"Colorado" class cruisers	„ 22.5 ..	1.149
Light cruisers, "Chester" type	„ 25 ..	1.1 to 1.23
Destroyers, 740-ton type	„ 29–30..	1.09 to 1.1

These figures serve to indicate that the naked resistance, which can be very accurately determined in the tank, is far from representing the work which the propeller is required to overcome.

Of these percentages, we have already dealt with the rudder. Bilge and docking keels, if properly placed, so that their planes do not interfere with the stream-line flow round the hull can be similarly dealt with as additional wetted surface. If, however, interference does take place, then a very serious and uncertain amount of extra resistance will be created. That bilge and docking keels together should account for an augment of 5.1 per cent. in Baden is not so surprising as that in Royal Sovereign no less than 13.1 per cent. should be absorbed in this manner.

Unless specific trials for the purpose of ascertaining their effect is made in the tank, the major difficulty which is encountered lies in apportioning the additional resistance due to shaft bossing and brackets. Quite apart from the very considerable influence which their design and location exerts on the propeller—an effect which we are not now considering—their presence at the stern affects resistance considerably ; 2.9 per cent. at 20 knots is the amount credited to the Royal Sovereign for four shaft brackets only. In torpedo craft the influence of brackets may be very serious—it has even resulted in failure to attain the designed speed in one well-known case. The amount of augment due to well-shaped and well-placed brackets may vary from about 2 per cent. of the naked resistance in a slow-speed vessel to about 6 or 8 per cent. in the case of a fast destroyer. In the latter types, the position of brackets is very important, owing to the considerable trim by the stern at high speeds. Nearly all the modern British torpedo craft have comparatively flat or very shallow V-shaped sterns, and the brackets therefore are V-shaped in relation to the vertical centre line of the ship. In many foreign destroyers, particularly those of the United States Navy, the after-body of torpedo craft is sharply V-shaped, and the brackets therefore are also of V-section, the lower arm being horizontal. In several of these, therefore, the axis of the lower arm has been inclined downwards at the leading edge, so that when running at full speed the axis is practically horizontal, but at lower powers the additional drag from this source must be considerable. The adoption of geared turbines has resulted in the fitting of very heavy brackets to destroyers. A standard speed of revolution of 350 per minute has been adopted in this country with consequently heavy shafts and exaggerated bracket sections, and it is probable that an increase in speed of rotation, even at a slight sacrifice of pitch ratio in the screw, would result in combined improvement, owing to the lighter shafts and brackets required. Two brackets per shaft have been found necessary in many of the recent United States battleships and in their destroyers. In the former cases, this applies to the twin-screw ships whether driven by turbines, as in the North Dakota or Nevada, or the latest reciprocating-engined vessels, such as the Oklahoma. So far, in British naval practice, even in very fine-sterned vessels, such as the Repulse or Hood, more than one bracket per shaft has not been adopted, but short stream-lined projecting bosses have been found necessary to contain the after-bearing of the stern tube, which is carried fairly far aft in order to avoid an exceptional length of tail shaft or the adoption of a tail shaft coupling outside the ship.

The most extensive experiments which have been conducted with shaft bossing are those published by Mr. Luke in the "Trans.," I.N.A., 1910. These were primarily made in connection with the wake and hull efficiency experiments carried out at Clydebank, but the resistance due to the bossing alone as compared with that of the naked model were given, as it was found that, quite apart from questions of hull efficiency or direction of rotation of propellers, the resistance of the model varied with the angle of the bossing as follows :—

Angle of bossing to horizontal— 0 deg.	22½ deg.	45 deg.	67½ deg.
Resistance with bossing and webs compared to resistance of naked model— 1.097	1.04	1.026	1.05

These experiments were conducted with a model having a ratio of beam ÷ draught of 3.33, and a prismatic coefficient of after-body of .719. It will be seen how, as the bossing flattens out, the interference with the natural stream-line flow of the water, which at this point is inwards and upwards as well as aft, is adverse in effect to an amount approaching 10 per cent. The least interference is met with at an angle of about 30 deg., but, going down, as the bossing becomes more vertical, the inward flow of the stream lines is affected and the resistance increases again.

The variation in speed-length ratio over which these experiments extended was between 0.6 and 1.0, and no such variations in percentage were found as those suggested by Admiral Dyson in the diagram which we reproduce. Nor is it quite clear why such extreme variations should arise. At a speed-length ratio of about .65 to .75, there is a distinct hump in the effective horse-power of some of the United States battleships, but this can hardly be entirely attributable to the influence of appendages. Rudders and docking keels would produce no change, and the variation appears too great to be effected by bilge keels and shaft brackets, although these particular vessels did tend slightly to alter their trim about the speeds of 15 to 17 knots. Scoops for circulating water inlets were at one time fitted to an abnormal extent in British destroyers, and in the case of one vessel were very generally credited with having a marked effect on her speed. Very little projection is needed to secure an ample supply of water.

But perhaps the major influence of appendages may lie not on resistance as is alone considered above, but on propulsion. The two influences are quite distinct, and we have purposely refrained from mixing them. When appendages are well designed, the only two that can affect propulsion are the bossing and the brackets. It is in obstruction of the flow of water to the propeller that these exert their most baneful influence. Short of water or fed with a supply at a considerable angle to the plane of the screw, a propeller will lose in efficiency very rapidly, and if the obstruction is sufficient to reduce the density of water in the neighbourhood of the screw, the reduction in propeller efficiency due to induced cavitation will probably be far greater than any increase of resistance of naked hull due to the fitting of well-designed and well-placed bossing or brackets.

Lift Locks on the Canal du Centre, Belgium.

The putting into service of what is known as the Canal du Centre has effected a new junction in southern Belgium between the basins of the Meuse and the Scheldt. Up till recently there was no direct means of communication between the two from Rupelmonde to La Fère, a distance, as the crow flies, of 175 kilomes., or, say, 109½ miles. The Canal du Centre is 21 kilomes.—just over 13 miles—long, and the difference in level between its two ends is 89.457 m., or, say, 293.5ft. The climb is effected, first of all, by six ordinary locks, which are spread over a distance of 8¾ miles, in the valley of the Haine, and which together represent a height of 76.3ft., and, secondly, by means of four lift locks in a length of 4¾ miles in the valley of the Thiriau, which is an effluent of the Haine. In that valley preference was given to lift locks rather than to locks of the ordinary type, partly because of its considerable slope, partly because of the scarcity of water, and partly because there are colliery workings in the neighbourhood. Furthermore, by choosing a smaller number of comparatively high lifts, it was possible in the case of three out of the four locks to found them on ground which is not likely to be troubled with subsidences, though in the fourth case it was necessary to put in foundations of a heavy character. The lift locks, with their respective lifts, are as follows :—

	Lift.
No. 1.—La Louvière	15.397 m., say, 50ft. 6in.
„ 2.—Houdeng-Aimeries ..	16.934 m., say, 55ft. 7in.
„ 3.—Bracquegnies	16.933 m., say, 55ft. 7in.
„ 4.—Thieu	16.933 m., say, 55ft. 7in.

The lock at La Louvière has been in service since as long ago as 1888, and the construction of the other three was stopped in the year 1894, after the masonry portions of their structure had been completed, because of difficulty experienced in making the section of the canal between locks 3 and 4 water-tight. In 1909 the Société John Cockerill, of Seraing, which had built the lock at La Louvière, was instructed to complete the three remaining locks, the metal work of which was to be furnished by the Ateliers de Construction de Hal. The erection had reached an advanced stage when the Great War broke out, and operations had, perforce, to be stopped. They were, however, recommenced after the Armistice, and the Canal du Centre is now in normal operation throughout its length. In the June issue of *Les Annales des Travaux Publics de Belgique* there was published an illustrated description of the four lock structures from the pen of Monsieur L. Van Wetter, Ingénieur principal des Ponts et Chaussées, by whose courtesy we are enabled to give the following particulars and to reproduce the illustrations given herewith and on page 218.

Advantage was taken of the experience gained with the lock at La Louvière to introduce certain improvements into the new locks. It may be explained that the lock at La Louvière consists of two steel basins or tanks, each having an internal length of 43 m.—say, 141ft.—and an internal width of 5.80 m., or, say, 19ft. Each tank is carried on the ram of an hydraulic cylinder, the rams being 2 m.—say, 6ft. 7in.—in diameter. The arrangements are such that in ordinary working one tank is raised and the other is lowered at the same time. For this purpose, the two hydraulic cylinders are connected together by piping, which is furnished with a valve. On opening the latter, the two tanks, if their weights were equal, would tend to take up positions at the same elevation, the lower one rising and the upper one falling till a hydrostatic balance was brought about. In practice, however, a greater depth of water is allowed to enter the tank which happens to be uppermost at the time, the increase in depth being 0.30 m., or, say, 11.8in. The added weight of water is then sufficient to raise the lower tank to the height of the upper canal, the tank, which was originally at the top, sinking to the level of the lower canal. Before it can be raised again the excess water has to be drained away into the lower canal. To permit of the flow of water from the upper canal into the lock basin, and from the latter into the lower canal when it has reached the level of the latter, there is a special arrangement by which the canal is connected to the basin, the chief feature of which is that the escape of water, saving from canal to basin and *vice versâ* as required, is prevented by scarfed surfaces, both on the end of the canal and on the end of the basin facing it, which surfaces are both provided with rubber pads. Both canal end and lock basin end are, in addition, of course, provided with lifting gates, the water-tightness of which is brought about by rubber packings. The gates on both canal and basin are lifted simultaneously by means of a chain and an hydraulic cylinder. The chain is permanently fixed to the canal gate, and the connection between it and the

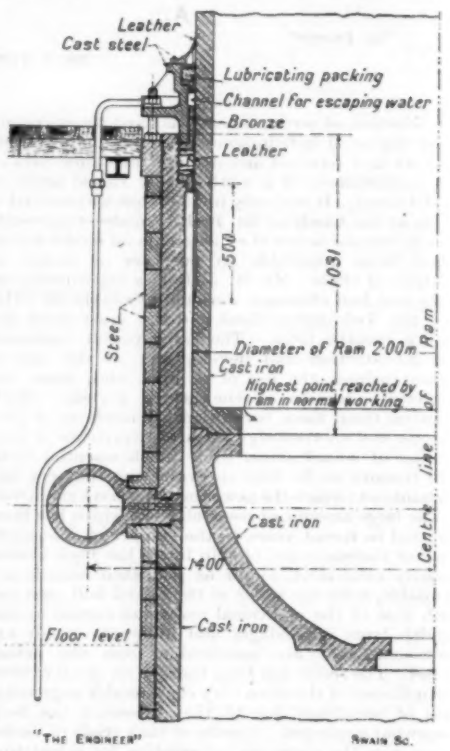
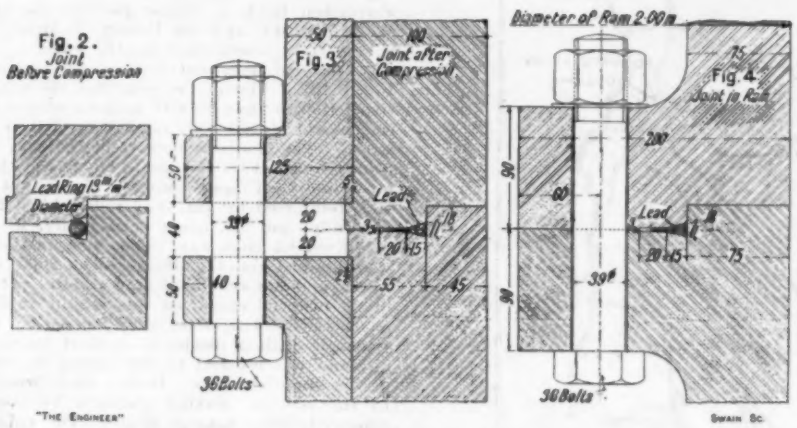


FIG. 1—HALF-SECTION OF BOTTOM OF RAM

basin gate, so that both may be raised or lowered together, is effected by hinged bolts. Before the mechanism is put in operation a small valve in the canal gate is opened, so as to fill the empty space between the two doors with water, and in that way the resistance due to friction caused by the horizontal pressure of the water on the gates in their guides is reduced to a minimum. The pressure water necessary for the various motions is produced by pumps driven by turbines actuated by the flow of water from the upper to the lower canal. The two lock basins at La Louvière are guided in their upward and downward travel by nine steelwork towers or pylons, tied together in their upper parts by steelwork girders, as may be seen in Fig. 8, page 218. The total weight supported by each ram is given as being 975 metric tons when the basin contains its normal depth of water, which is 2.40 m.

The experience gained with the La Louvière lock led to certain alterations in design being adopted for the three later locks. For example, the number of guide pylons was reduced from nine to three—see Figs. 10, 11, and 13, page 218. The end of the basin which makes junction with the upper canal is, however, carried in guides which are fixed in the masonry of the upper canal. The centre pylon is also tied to the masonry by a steel girder which also serves to carry a gangway. The shape of the girders forming the sides of the lifting basins was also altered, as will be gathered from the illustrations. A good many alterations were also made in the machinery. For instance, whereas the rings of the stuffing-boxes of the main rams at La Louvière are entirely of bronze, those at the second, third and fourth lifts are for the most part made of cast steel, there being only a comparatively small internal packing ring of bronze.

The construction of the presses at the new locks is shown in Fig. 1. It will be seen that, in addition to the usual packing leathers, there is also a further packing which is impregnated with grease and which serves the purpose of keeping the ram lubricated. The two packings are separated by a channel to catch and drain away water escaping past the leathers, and thus to prevent its reaching the lubricating packing. At La Louvière, too, the joints between the different parts of the press are made with sheet lead, which has the defect of squeezing out, so that pieces of the metal find their way into the interior of the ram cylinder. The form of joint employed in the three newer installations is shown in Figs. 2 and 3.



FIGS. 2, 3, AND 4—LEAD JOINTS IN HYDRAULIC CYLINDER AND RAM

Instead of sheet lead, lead rings of circular cross section are used, as seen in Fig. 2, which depicts the joints in the body of the hydraulic cylinder before the bolts are tightened up. Fig. 3 shows the joint tightened up and the lead squeezed so as to fill the dovetail-shaped orifice between the two parts of the cylinder. The same type of joint is used for the rams, as may be seen in Fig. 4.

The control cabin in each of the three later lifts is situated above the central guiding pylon. It is provided with glazed windows reaching down to its floor level, so that the attendant has a good view of everything under his control. The cabin contains indicators of various descriptions. First of all, there is that which shows the movements of the lock basins.

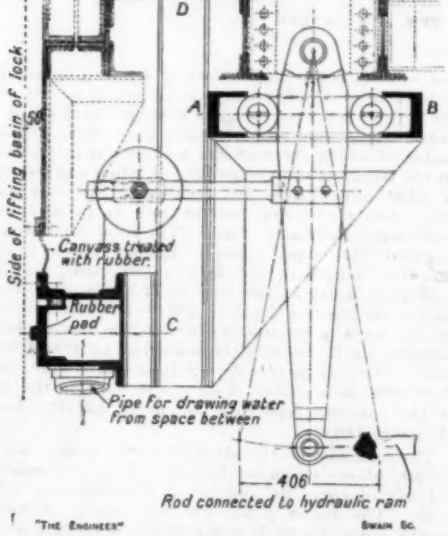


FIG. 5—METHOD OF MAKING WATERTIGHT JOINT

It consists of a dial furnished with two pointers, one for each basin, and both working in the same direction, and the arrangement is such that one pointer comesover the other when the two basins are opposite the upper and the lower canals respectively. Since, actually, the basin which is being raised has to be stopped before reaching its highest level, so as to enable the extra water to be taken on board for the descent, the two pointers are, when that point is reached, separated by a small angle. Any variation of that angle during operations informs the attendant of the fact that there must be a leakage in the presses or in the piping leading from them.

Then, again, each basin, as it approaches the upper end of its travel, lifts a rod provided with a pointer, which travels up and down a graduated fixed scale. There is a similar arrangement for the basin which is being lowered. Bells show when the end of the lift has been reached, and the attendant can with the aid of these indications bring the basins to their correct positions with great accuracy. In case, however, he fails for any reason to stop the basins in the desired positions, the basins themselves open either admission or discharge valves, according as they tend to descend too low or to rise too high. If, however, that does not do what is required, the descending basin will come to rest on chocks in the pit into which the basin descends, while in the case of the ascending lift, the pressure water will be allowed to escape past the packing because the ram is reduced in diameter, as seen in Fig. 1. When working normally the portion with the reduced diameter does not rise as far as the packing leathers, but if the proper height is exceeded, the packing leathers are overrun and the pressure water naturally escapes past them.

The method used at La Louvière to connect the basins to the canals is the same as that employed for the lift lock at Anderton in this country and for the floating lift at Henrichenbourg on the Dortmund-Ems Canal. The method employed for the other three locks is illustrated in Fig. 6. The end of the basin is vertical, and the joint between it and the end of the canal is made by means of a swinging U-shaped frame, which is connected to the end of the canal by flexible water-tight canvas, and is furnished on the

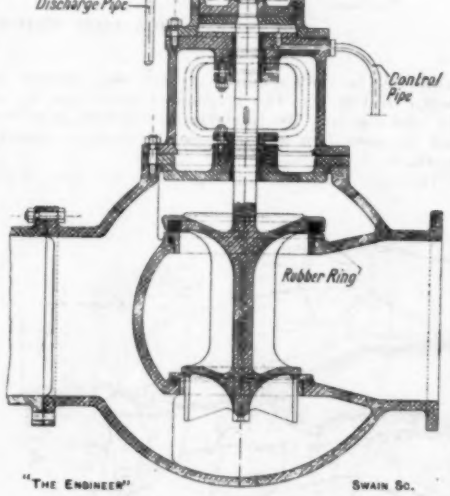


FIG. 6—AUTOMATIC HYDRAULIC VALVE

side facing the basin with a rubber buffer. When the frame and rubber buffer are pressed against the end of the basin by means of a small hydraulic cylinder an effective joint is made. The necessary pressure is transferred from the hydraulic cylinder through connecting-rods, the horizontal girder A B and two transverse joists C, D. Pressure can be applied almost instantaneously, for the travel of the hydraulic piston, the diameter of which is only 4¼in., is less than 8in.

The rubber packing to keep the gates water-tight is attached to the gates themselves, and not to the grooves in which they work, so that repairs and renewals can be carried out with as little interference with navigation as possible.

The water draining from the space between the lower canal and the basin, and as well as that arising from leakage, is collected in sumps in the pits containing the main hydraulic lifting cylinders. At lift No. 2—that known as Houdeng-Aimeries—the water is got rid of by leading it to a channel which discharges below lift No. 3. At lifts Nos. 3 and 4 a Koerting ejector, actuated by water from the upper canal, is arranged in each sump, and it keeps the water level down to several metres below the bottoms of the cylinder pits. There are other ejectors to empty each sump completely when it is necessary to effect repairs. A special ejector, which can get rid of 300 cubic metres per hour, is installed, so that the cylinder pit at lift No. 3 can be rapidly cleared of water, should it become accidentally flooded, and a centrifugal pump is provided at lift No. 4 for the same object.

The hydraulic station which provides the pressure water for lifts 2 and 3 is situated below the latter. It is worked by water taken from the canal above lift No. 2, so that there is a head of 33.867 m., say, 111ft. It contains two sets of machines, each composed of a turbine and a pump, and each capable of supplying 48 cubic metres of water at a pressure of 50 kilos. per square centimetre—say, 1680 cubic feet at a pressure of 711 lb. per square inch per hour. There are two accumulators, each having a piston 0.5 m. in diameter, the respective strokes being 7.7 m. and 7.2 m. The turbines have horizontal axes and run normally at 90 revolutions per minute. The shaft carries two cranks, set at 90 deg. apart, which work the pump plungers, which have a diameter of 100 mm.—nearly 4in.—and a stroke of 300 mm.—say, 11¾in. The starting and stopping of the turbines is effected automatically by means of the heavier accumulator, which, at the top and bottom of its stroke, puts into operation an hydraulic servomotor which, in its turn, controls a valve in the

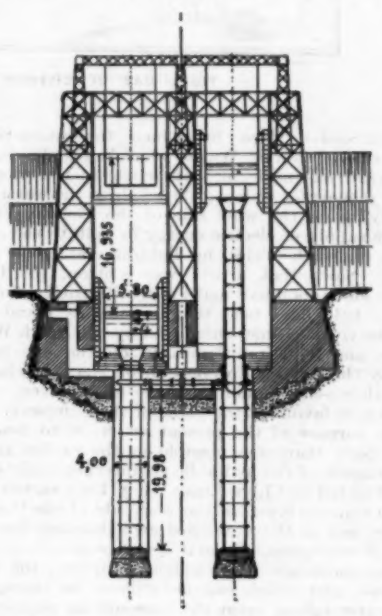


FIG. 7—SECTION THROUGH LIFT-LOCK No. 2

supply pipe to each turbine. The valve, which has to be so arranged that it cannot be closed in less than 20 sec. for fear of water hammer, is shown in Fig. 6. It is double beat, and the upper valve is furnished with a rubber ring, so that both valves may come on their seats at the same moment. The spindle of the valve is prolonged upwards and carries two pistons, the upper of which is constantly subjected to the pressure of the pressure water, and tends to close the valve. The lower face of the other piston, which is of larger diameter than its fellow, is only subjected to the pressure of the pressure water when the accumulator reaches the bottom of its stroke, and when it is so subjected the valve is opened. When the accumulator reaches the top of its stroke the lower cylinder is put to exhaust, and the valve closes. These motions are controlled by a cylindrical distributor, which is actuated by the accumulator. The speed of opening or of closing the valve may be regulated at will by throttling more or less completely the pipe connecting the distributor to the valve.

A further power-house serves lift No. 4. It also is hydraulically operated, the gross available head being about 55ft. 6in. The hydraulic machinery is of the same type as that at Bracquegnies, and in duplicate. Each hydraulic pump, however, can only supply 24 cubic metres of water per hour at a pressure of 45 kilos. per square centimetre. There is one accumulator with a diameter of 0.5 m. and a stroke of 7.70 m.

THE latest concession given by the English railway companies is a reduction in the price of traders' tickets. The qualification is to be an annual traffic of £600 a year instead of £1000, the price will be 50 per cent. above pre-war level, and the minimum charge will be based upon a distance of 40 miles instead of 50 miles.

Water-Power Developments in North Wales.

By JOHN B. C. KERSHAW.

The issue of The Engineer for February 25th contained an article by the present writer describing the successive steps by which the water-power resources of North Wales were being developed. Reference was made in that article to the progress of the scheme for utilising the whole of the watershed area lying on the west side of the Conway Valley for the supply of electric energy in bulk to the coast towns of North Wales, for lighting and power purposes. Since that article was written, the Commissioners appointed under the Electricity Supply Act of 1919 have held their inquiry at Llandudno into the rival schemes submitted by the North Wales Power and Traction Company, on the one hand, and by the Chester Corporation on the other hand; and they—the Commissioners—have given their decision in favour of the plans of the Company.

The purpose of the present article is to describe more fully than was possible in the earlier article the progress of the hydraulic engineering works upon Llyn Cowlyd and Llyn Eigau. Fig. 1 is a sketch map of the country lying on the west side of the Conway Valley, and of the watershed area draining into the river of that name. From it it will be seen that there are six mountain lakes which drain into the river Conway, and which can be utilised for storage of the water falling upon the surrounding mountains, which vary from 2000ft. to 2700ft. in height. The three lakes, known locally as Llyns Dulyn, Melynllyn and Cowlyd, lie above the 1000ft. level, and are already utilised for the supply of drinking water to Llandudno, Conway, Colwyn Bay, and the surrounding townships; the surplus water flowing from them being used to generate electric energy at the Dolgarrog power station. In time, no doubt, the water of Llyns Crafnant and Geirionnydd, lying to the south-east of Llyn Cowlyd, will be similarly utilised.

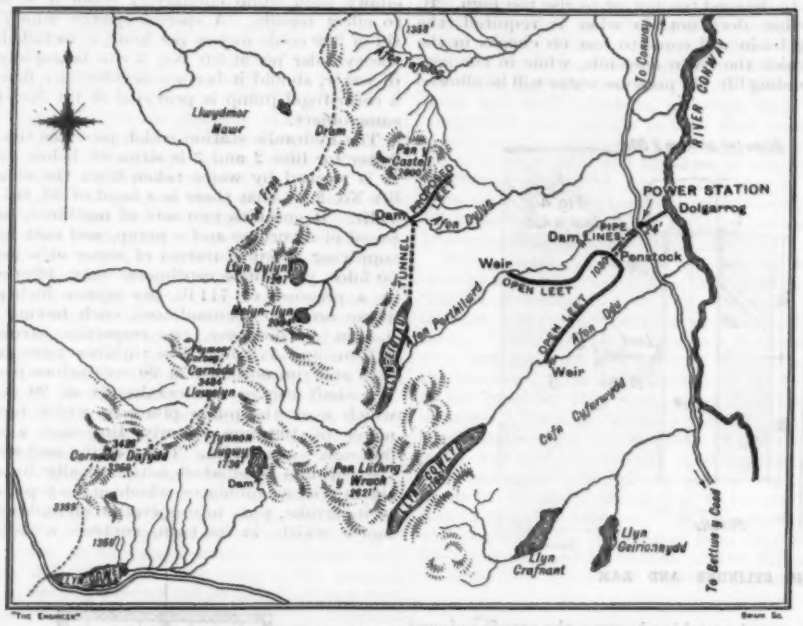


FIG. 1—MAP OF DISTRICT TO WEST OF THE RIVER CONWAY

The original dam which converted Llyn Cowlyd into a reservoir is 176 yards in length. It was constructed in 1892 by the Conway and Colwyn Bay Joint Water Board, from the plans of the late Mr. T. B. Farrington, the Board's consulting engineer at that date. It is only necessary to refer to the fact here in order to explain that the new dam which is now approaching completion is built some distance lower down the valley, and will increase the depth of the lake by 37ft., and its storage capacity to 3110 million gallons. The gradients of the surrounding land, except at the north-east end of the valley where the dam is constructed, are quite steep; and the area of the lake when the water has risen and has flowed over the spillway of the new dam, will be only slightly greater than before, as shown in Fig. 2. The original storage capacity of the lake was only 700 to 800 million gallons, however, and the new dam will increase the storage capacity fourfold.

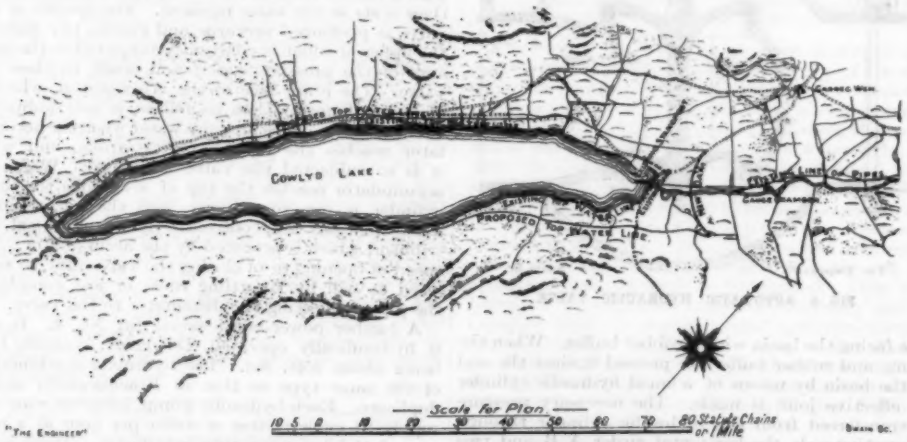


FIG. 2—PLAN OF COWLYD LAKE, SHOWING NEW TOP-WATER LINE

The dam has been constructed at the cost of the Aluminium Corporation, under an agreement with the Conway and Colwyn Bay Joint Water Board, dated May, 1916, under which the Board is entitled to the whole of the water in the lake below the 1169ft. level above Ordnance Datum. The Aluminium Corporation, for the purpose of taking water from the lake, for its own use, agreed to construct and maintain an outlet at a point on the new dam, in such a position that the invert of the pipe should not be at a lower level than 1169ft. above Ordnance Datum. The Corporation, under the agreement, however, was to be at liberty to bring water into the new lake from any other gathering grounds, provided the Board was satisfied that such gathering grounds were free from all human habitations, and that the water was pure and of a character suitable for the Board's duties.

The work of excavating for the dam was commenced in the summer of 1916, but the scarcity of labour owing to the war delayed progress, and it is only now that the works are approaching completion. Sir Douglas Fox and Partners are the consulting engineers for the Aluminium Corporation; Mr. C. F. Farrington holds a similar position for the Joint Water Board; and Sir Robert McAlpine and Co. have been the contractors for the work.

A sectional elevation of the new dam is shown in Fig. 3, from which it is seen that the dam is constructed of earthwork, with an inner core of Portland cement, which has been carried down to impervious strata. This concrete core wall varies in thickness from 4ft. 6in. at the bottom to 6ft. 6in. at the ground level, and then tapers away to 2ft. 6in. at the top. It is reinforced by ½in. steel rods, placed 2ft. apart vertically, and 4ft. apart horizontally, with stirrup bars fixed 4ft. each way. The stone for the concrete was obtained from the hillside, about 200ft. above the works, and is a very hard grey granite. The smaller filling material employed was granite dust crushed on the site. The stone was quarried by means of Ingersoll drilling machines, worked by compressed air, and was crushed at the quarry by electrically driven stone crushers. It was then brought down to the concrete mixing platform by means of a counter-balance haulage drum. The concrete was mixed by means of two Ransome concrete mixers, 1 cubic yard capacity each, and from them it was taken to the dam. All the machinery was electrically operated, the supply of current being obtained from the Cwm Dyli power station, which is situated at the foot of Snowdon. The transmission line from this generating station passes through the Cowlyd Valley, a locally installed transformer reducing the voltage from 20,000 to 440 for use at the works.

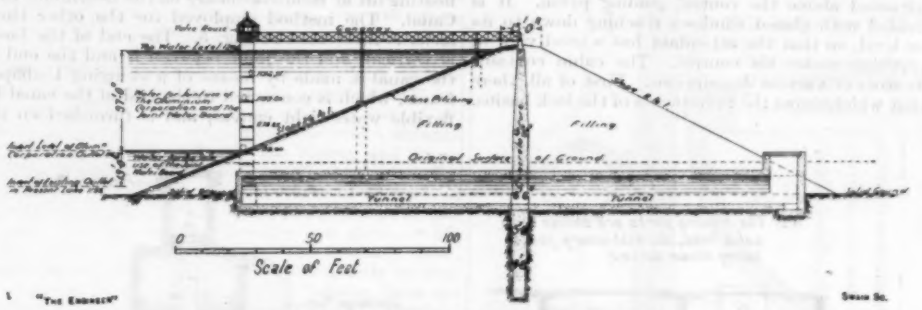


FIG. 3—CROSS SECTION OF NEW COWLYD DAM

The earth filling for the dam was excavated by means of a 20-ton Ruston and Proctor's steam navvy, and was conveyed to the dam in wagons, by means of locomotives and steam-haulage winches. At the site of the dam these wagons were lifted intact by a 15-ton Henderson derrick having an 80ft. jib, by means of which the material was placed in position on the bank. The average rate of filling worked out at 3200 cubic yards per week—on a 10-hour day basis—the maximum amount put in in any one week being 4000 cubic yards. The total earth filling required was approximately 120,000 cubic yards. The total length of the dam is 450 yards, and its maximum width at the base is 72 yards. The core wall at its greatest depth is 50ft. below the original ground level, a satisfactory foundation having been obtained for it either in the solid rock or in stiff blue clay. The top of the dam will be 15ft. wide, and there will be a rubble stone storm wall on the top of the concrete core to a height of 1211ft. above Ordnance Datum.

The spillway of the dam is 160ft. wide, and is 1206ft. above Ordnance Datum. It is constructed entirely of concrete, and has a foundation of solid rock. The outlet pipes for the supply of water to the Joint Water Board and the Corporation are contained in a tunnel of rectangular section, constructed through the base of the dam. This tunnel is 11ft. wide by 10ft. 6in. high, and is constructed of concrete, with a semi-circular roof. It contains the existing 24in. water main of the Joint Water Board, with provision for another 24in. main; and also the 48in. main outlet pipe for the Aluminium Corporation. The inner slope of the dam is 2½ to 1, with a 15in. stone pitching set on edge; while the outer slope is to be sodded or seeded.

A new 5ft. diameter cast iron water tower has been erected for drawing off the water from the dam at various levels; sluice valves being provided at 13ft., 22ft., 31ft. and 40ft. respectively, above the level of the existing outlet from the lake. The lake is very difficult of access from the Conway Valley,

the only road to it, from Trefriw, being steep and with its surface in very bad condition. A 2ft. gauge works railway had therefore to be constructed from the lake, for a distance of 3 miles, to the top of the existing incline belonging to the Aluminium Corporation. This incline has a lift of 825ft. in 700 yards, and all the engineering plant and concrete were hauled up this incline by steam power, and transported to the site of the dam by the narrow-gauge railway. For these and other reasons the progress of the work has been slow, but the dam is now completed, and the ceremony of opening the valves on the new water tower will take place at an early date. Two views of the dam works, taken in July of the present year, are shown in Figs. 4 and 5.

The Aluminium Corporation's outlet pipe, which is 4in. internal diameter, will be controlled from a concrete water tower constructed at the end of the tunnel. Under the agreement already referred to, the 13ft. of water in the lake below the 1169ft. level will be reserved for the sole use of the Conway and Colwyn Bay Joint Water Board; while the 37ft. of water above this level will be for the use of the Aluminium Corporation and the Board conjointly. The domestic water supply of the towns and districts which depend upon Lake Cowlyd is therefore doubly assured under the agreement; for in years of drought there will be a much larger reservoir of water to draw upon, and when the lake falls to its original level, the Aluminium Corporation will no longer share in the water.

Llyn Eigau has up to the present time been the chief source of the water supply for the power plant at Dolgarrog. The lake is situated to the north of Llyn Cowlyd, and is of much smaller superficial area, but it drains an equally valuable and important watershed. A concrete dam has been constructed by the Aluminium Corporation at the lower end of this lake, and a tunnel has been driven through the mountain which separates Llyn Eigau from the valley down which passes the outflow from Llyns Dulyn and Melynllyn. In this manner the surplus water of another watershed area to the north-west (which provides the supply for Llandudno) is diverted into Llyn Eigau, from which the water flows down the valley of Afon Porthllwyd for a distance of two miles, and is then conveyed by an open leet or catch-water along the mountain side to a concentration reservoir and penstock, situated 1030ft. above the Dolgarrog generating station, where it is joined by a similar leet, bringing the overflow water from Llyn Cowlyd. A 36in. diameter steel pipe line conveys the water down to the generating station at Dolgarrog. The contour of the ground and the pipe line down to Dolgarrog was shown in Fig. 1 in the article quoted above.

The writer's thanks are due to Mr. C. F. Farrington, consulting engineer for the Conway and Colwyn Bay Joint Water Board, and to Mr. Paton, chief engineer of the Aluminium Corporation, for information and illustrations used in the preparation of this article.

THE electric wiring in a building or a steamship may become damaged by fire or other causes, cutting off the supply and occasioning total darkness at the very moment that light is required. Such failure may cause serious accidents, especially in crowded places. An arrangement described in a German publication obviates this possibility. It consists of two lamps, one connected to the mains and the other to a 4-volt accumulator. So long as current passes through the main lamp, the 4-volt lamp remains cut out; on failure of the current a small armature retained by a solenoid in circuit with the mains is released and switches in the emergency lamp. The lamp switches are interlocked in such a way that the main current cannot light its lamp unless the safety lamp is in working condition.

Notes on Trevithick's Locomotives.

From the Journals and Memoranda of SIMON GOODRICH, M. Inst. C.E.

By E. A. FORWARD.

SIMON GOODRICH was born on October 28th, 1773, and entered the office of Sir Samuel Bentham, Inspector-General of Naval Works, as draughtsman, on December 25th, 1796. On October 25th, 1799, he was appointed mechanist, which post he occupied until December 25th, 1812, when the Inspector-General's office and staff were abolished, while for two years of this period he deputised for Sir Samuel Bentham who was absent in Russia. After being employed in a consultant capacity until April, 1814, he was re-appointed as engineer and mechanist to the Navy Board, which position he occupied until his retirement in 1831. During Bentham's *régime*, Goodrich was his right-hand man and carried into effect the various engineering schemes proposed by Bentham for the Dockyards. His official position thus brought Goodrich into contact with most of the eminent engineers of his day, including Boulton and Watt, Maudslay and Field, Brunel, Fenton and Murray, Gurney, Farey, &c., and last, but not least, Trevithick himself.

Following Bentham's example, Goodrich kept a journal and memorandum book, but this is unfortunately not uniformly complete over the whole period. The existing volumes commence in 1802, and continue, with gaps, until 1845; they contain interesting references, often with sketches, relating to the engineering works of all kinds which came under his notice, but we are concerned here only with references to Trevithick's engines. Besides the journals Goodrich left a large number of drawings, manuscripts and letters, some of which are of great interest.

The earliest and most valuable item found is a memorandum on a foolscap sheet watermarked 1801. The exact date when it was written is not given; but "about 1800" has been written on it by Goodrich subsequently. The contents, however, as will be shown, fix the date as March or April, 1803, when Trevithick was in London and probably communicated the information personally to Goodrich. The memorandum reads as follows:—

"Mr. Trevithic's engine at Colebrook Dale consumed 112 lb Coals pr hour, 30 strokes per mint. Dia. of steam cylinder 5in., length of stroke 3 ft., worked a Double Pump 3 ft. stroke 10in Diam, raising the water 37 high.—about 230,000 lb. 1 ft. high in a minute. 1 cwt of coals. This experiment was made under unfavourable circumstances—14 Million with 1 Cwt. 1 ft. high. Mr. Trevithic found the best of Mr. Bolton's engines with strong Welch Coals lift 20 Millions 1 ft. high with 1 Cwt of Coal.—this was when the Engines were in good trim and with the large Engines of 150 horse Power, Pumps 9 ft. stroke.—"

"Mr. T has prepared an Engine for driving a coach, Diam. of Cylinder 5½ Stroke 2 ft. 6 in. 50 strokes Per Min't work on each side Piston 20 lb Pr inch, in the boiler 30 lb.—about 110,000 lb. 1 ft high in a minute. The whole engine, fire and all is 6 cwt—The whole is contained within a cylinder boiler—2–9 long, 2–6 Diamr."

Following the memorandum is a carefully drawn pencil sketch to a scale of 1in. to a foot, and a copy of this is on the next page.

It appears that at some subsequent time, in looking over the memorandum, Goodrich wrote "about 1800" at the top of the sheet, and amended the pressure on the piston of the coach engine from 30 lb. to 20 lb.

From the similarity of the figures given in the first paragraph to those given by Trevithick to Mr. Giddy in a letter dated August 22nd, 1802—see Trevithick's Life, Vol. I., page 153—it would seem that Goodrich's memorandum refers to the same engine, which at that time had just been tested. He, however, gives the cylinder diameter as 5in., instead of Trevithick's 7in., and at the same time gives the lift as 37ft., as against Trevithick's 35ft., so that it appears as though Goodrich had transposed the 5 and the 7 in the hurry of writing the note. It is to be observed that the duty given is calculated on the assumption that the 30 strokes per minute means revolutions of the crank.

We know from Lady Bentham's Life of Sir Samuel Bentham, that he and Goodrich were absent on a provincial tour for the first two months of 1803, but the latter's journal is a blank over this period. It is also known from Trevithick's letters that he was in London early in April, 1803, and that he was sent for to the Admiralty Office to explain his engine. An officer was then sent to inspect an engine he had just erected in London—see the Life, Vol. I., page 158. There can be little doubt that Goodrich was the person deputed to carry out the inspection, meeting Trevithick for the first time on that occasion, and it is highly probable that the memorandum was written at that time. Vivian's account book, quoted in the Life, Vol. I., page 227, shows that Sir Samuel Bentham ordered a 14 horse-power engine for Deptford Dockyard in the same year, the price of which was £750.

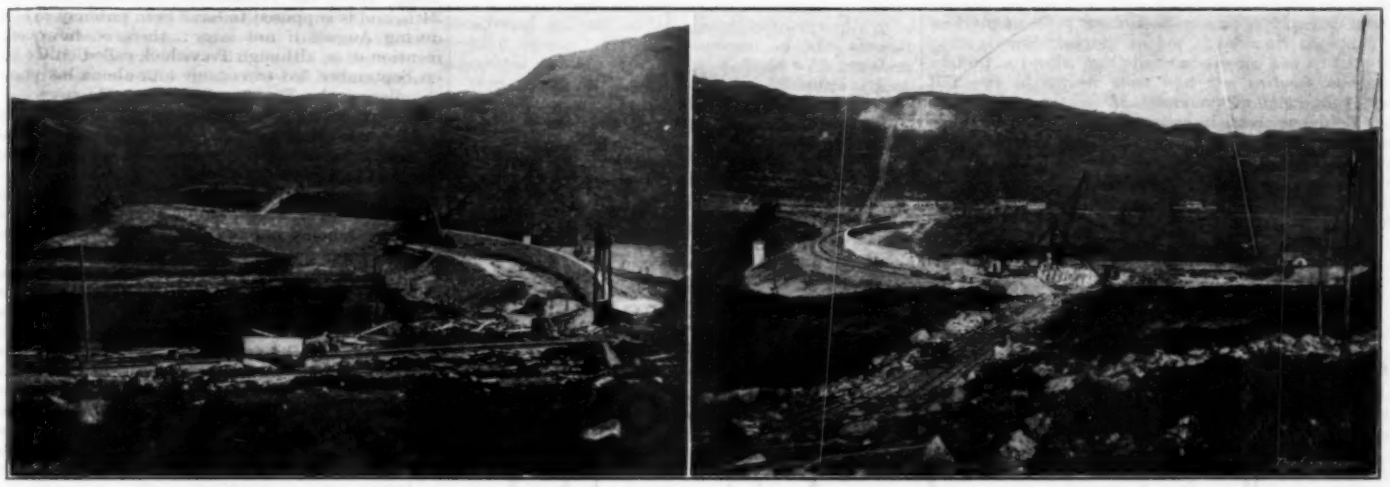
Trevithick's letter of May 2nd, 1803—the Life page 158—contains the only authentic information about the London coach engine. He gave the cylinder diameter as 5½in., and the stroke 2ft. 6in., and said that it had worked with perfect satisfaction at 50 strokes per minute with a steam pressure of 30 lb. The chimney was 2ft. high, and the engine had arrived in London on the Wednesday before he wrote.

Goodrich's memorandum gives us the additional information that the complete engine and boiler weighed 6 cwt., and that the whole was contained in a cylindrical boiler, 2ft. 9in. long and 2ft. 6in. diameter, the latter dimensions showing that Hyde Clarke's "orchestra drum" description was not far from the truth. The figure given for the power of the engine can only be obtained on the assumption that the 50 strokes per minute really meant revolutions, and that the steam pressure was actually throttled down to 20 lb. in the cylinder, as indicated by the amended pressure figure.

Turning now to the sketch, which shows longitudinal and transverse sections of the engine and boiler, we see that while it generally resembles the patent drawing, it is internally quite different. The shell appears to be made of wrought iron, about 0.25in. thick, with flat ends flanged round outside the barrel. The furnace tube is 21in. diameter, runs the whole length of the shell, and has a flat end with a small water space behind it. The grate occupies the full length of the tube, inclining slightly downward towards the back, and has an area of 4 square feet. Near the rear end of the furnace two oval flue tubes, measuring about 7in. by 5in., branch out and return, one on each side, passing through the front plate, and being connected by a breeches tube with the chimney, which is about 6in. diameter, and finishes approximately at the height of 2ft. above the boiler. The water space is comparatively small.

On calculating the heating surface of this boiler, it is found to be about 21 square feet, exclusive of the portion below the grate, which is 5 square feet. Mr. Pendred, in his paper before the Newcomen Society, thought that, with Trevithick's ordinary return flue design, it would be impossible to obtain more than 10 or 12 square feet of heating surface, but with this construction almost twice as much surface is obtained. Consequently, the horse-power of the boiler, using Mr. Pendred's figures, would be nearly 4 instead of only 2, while the engine itself developed about 3 horse-power according to Mr. Goodrich's figures.

The sketch shows the cylinder lying horizontally close to the top of the boiler, and the projecting end,

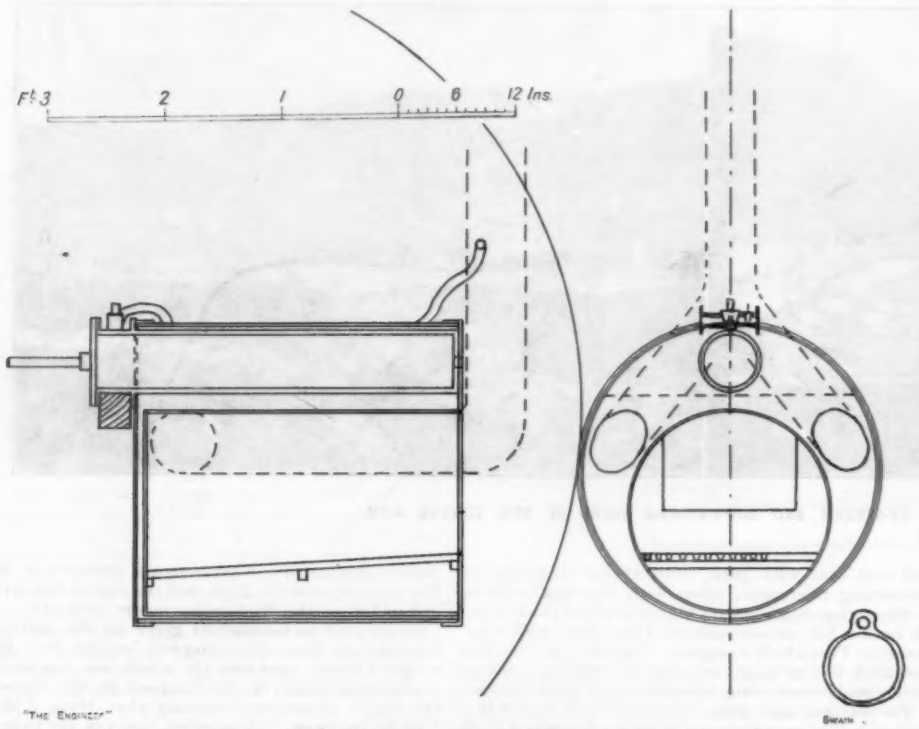


FIGS. 4 AND 5—UP-STREAM AND DOWN-STREAM VIEWS OF NEW COWLYD DAM

which carries the steam cock, rests on the coach axle; the large circle, struck from the centre of the latter, is obviously intended to represent the coach wheel, and is 8ft. diameter. The four-way cock is shown, together with the exhaust pipe leading into the chimney. A cross section of the cylinder is also added to show the steam port leading to the inner end. In the sketch the cylinder is shown rather too near the shell to admit this steam port along the top. It is to be regretted that the sketch shows no more of the coach or gearing, and still more so that Goodrich did not leave a record of his having seen it running. It is not known whether he saw the engine at the time the memorandum was made, but probably he had not, as it appears from Trevithick's letter of May 2nd, 1803, that it did not arrive in London until April 27th of that year.

In the Journal itself, the first note of Trevithick's engines occurs on March 9th, 1804. Goodrich then records that "A Mr. Homfray, Iron Founder from Pendarron Works in Wales, has been in Town and invited me to go thither at his expense for the purpose of witnessing experiments with Trevithic engines a part of whose Patent he has bought—Was to have set off tomorrow but have rec^{d}. a letter today in which he wishes to defer the Journey a month or so; this exactly agrees with my own wishes upon the subject—."

Now we know from a letter of Trevithick's—the Life, page 159—that the tram wagon engine was first worked on Saturday, February 11th, 1804, and first put on the tram road on Monday, February 13th. Moreover, Mr. Homfray was in London early in



FACSIMILE OF SKETCH OF TREVITHICK ENGINE AND BOILER

February, and presumably then saw Goodrich and invited him to witness the trials. Trevithick, in his letters to Mr. Giddy of February 20th and 22nd, 1804—the Life, pages 160 and 161—mentions the two engineers from Woolwich and the Admiralty who were to go to Penydarran, and it appears from a letter from Homfray, which has been preserved, that Simon Goodrich was the engineer from the Admiralty and Lieut. Cunningham the one from Woolwich. This letter, addressed to Goodrich, is as follows:—

"Penydarran Place
"Nr. Cardiff 27th. Feby 1804

"Dear Sir.

"I have the satisfaction to inform you the Tram Road Engine goes off very well—we have made a Journey on our Tram Road 9½ miles in length—it took 10 Tons long w^{t}. of Iron, & about 60 or 70 people riding on the Trams—which added 4 or 5 tons more to the w^{t}.—it goes very easy 4 miles an hour, & is as tractable as a Horse, will back its load, & move it forward as little (& slow) at a time as you please—With this Engine we can make the different tryals, & I am now preparing a pump to lift water, a Barrell to wind a Ball up and down, with any other matters I may think you would like to see it do—& move it about from place to place—these preparations will take about a fortnight—that if it is convenient and agreeable, I shall be happy to meet you & Lieut. Cunningham, on Saturday the 10th. March or Sunday the 11th.—at Newport—& will endeavour to make the Journey as interesting as I can to you both—& you will be so good to settle as soon as possible with Lieut. Cunningnam which of the days I shall have the pleasure of meeting you, & write to me accordingly. You will travel in any manner most agreeable to yourselves—but if you prefer expedition, with little trouble, the Mail Coach to Bristol is the best—& then come on in the Welch Mail to Newport, where you will arrive about 7'o.clock the next evening after you leave London—& where you will find me waiting your arrival at the King's Head—on receiving your answer to say you will be there—I hope this time will suit you as you mentioned you thought in a fortnight or three weeks, from the time I saw you, you could better spare the time than to come down with me—I hope Gen'l Bentham will be agreeable.—

"I am D^{r} Sir
"Your most ob. Serv^{t}.
"SAML. HOMFRAY."

As Goodrich records in his Journal, this visit, fixed for March 10th or 11th was put off by a letter he received from Mr. Homfray on the 9th. This letter also exists, and reads as follows:—

"Penydarran Place
"March 7th.

"Dear Sir.

"I am concerned at being obliged to put off your Journey with Lieut Cunningham for the present—more especially on acc^{t}. of the reason.

"I have yesterday had a very narrow escape—driving a Gig with a young Lady in it—the Horse wd. not hold back going down Hill & run away & throwed us both out—thank God no bones were broke—the Lady escaped wonderfully with only a hurt on the leg—but I have suffered more—I dislocated my elbow and strained my leg, bruised my face &c—but nothing from which any bad circumstances are likely to arise—My elbow is reduced again to its place & I now write this as I lye in bed. I hope to get about again by the end of the month. & that I shall then see you both down here as the different things to try are nearly ready for your inspection—but as I get better will write to you.

"I am D^{r} Sir yours &c
"SAML. HOMFRAY."

This unfortunate accident to Mr. Homfray, which is also recorded by Trevithick in a letter to Mr. Giddy, dated March 9th—the Life, page 168—as it turned out, put off the official trial for good, there being no record of Goodrich having visited Penydarran at this time. From April 1st until the end of August, he was employed on journeys in the provinces, while Lieut. Cunningham was ordered to Chatham even before the appointed date, so that the golden opportunity was lost, and as the result we are deprived of an authentic contemporary account of the Penydarran locomotive of 1804.

The next mention of Trevithick in the Journal occurs on January 3rd, 1807:—

"Mr. Trevithic calls and offers to take away the Mud raised by the Deptford Ballast Engine for 1^{s} /6 per ton. He promises to call at the office on Monday with the small model of his Steam Engine.

"Monday. 5th. Jan. 1807.

"Mr. Trevithic calls and exhibits his small model of a pressure steam engine, a heater of iron being made red hot was put into it to heat about 3 pints of boiling water. The boiler was a cylinder of copper with a flue through it occupied by the heater, the steam cylinder was at one end about 1¼ in. diam. The whole was placed upon three wheels and two connecting rods from the Piston rod gave motion to the two hind wheels by the intervention of two cogged wheels. It was very amusing to to see the little thing run round upon the large table in the Upper Room for about a quarter of an hour—There was nothing in the construction particularly well adapted for moving a carriage, it was merely a model that might move in this manner upon a level table, for although the fore wheel was set at an angle to cause it to move in a circle, yet the two hind wheels, by a determinate connection, were both obliged to make the same number of revolutions; there was also the addition of a flywheel on a separate shaft.—Went with Trevithic to look at an engine upon his plan erecting at a Cotton Manufactory in Tottenham Court Road—From Trevithic's account it would appear that his Engines are getting much into use and that from experiments which have been made they surpass Watt's Engines in the economy of fuel—but I do not consider this account satisfactory altho' I wish it may prove so, for notwithstanding that another of them has burst lately in Wales, I am of opinion sufficient means of Safety might be adopted."

This description of the model, except for one minor error, exactly describes the three-wheeled model now in the Science Museum, and, unless there were other models absolutely identical, it shows that this model was in Trevithick's own possession at that date.

Coming now to the year 1808, in which the London track locomotive was run, we might have expected to find some mention of it, but none can be found. The Journal is complete from January 1st to June 23rd, but is a perfect blank from thence until August 12th, while he notes his return to London on August 20th. Now, the locomotive was tried about July 24th, and is supposed to have been publicly exhibited during August if not later; there is, however, no mention of it, although Trevithick called on Goodrich on September 3rd to consult him about his plan for completing the Thames Archway. He says:—

"I find it like one I had conceived and made some memoranda of some time since and approve of it as the only way likely to succeed—Go with him to see his Plans.

"5th. Sep^{r}. Write to Mr. Trevithic my opinion of his Plan of laying an Iron Tunnel across the River Thames, it being like my own ideas on the subject I conceive it practicable."

There can be little doubt but that Trevithick's difficulties in connection with the Thames Archway distracted his attention from his London locomotive of 1808, and the above note is particularly interesting as showing that he actually proposed an *iron* tunnel. Trevithick, apparently, never again turned his attention to locomotives, even when others had made a practical success of them. He did, however, after his return from South America, make attempts to introduce his high-pressure engines in steam vessels, and Goodrich's Journal records meetings with him, in 1830, in this connection.

We have, then, to thank Simon Goodrich for at least one extremely valuable link in the history of Trevithick's locomotives, while at the same time it is most tantalising to find that he was prevented by circumstances, or by the loss of parts of his Journal, from leaving us more on the same subject. In conclusion, we give an interesting extract from a lecture on the Steam Engine given by Goodrich in 1833. Whether it is based on facts within his own knowledge is uncertain, but as it differs from other early accounts it is worth recording:—

"Mr. Trevithic first brought into use the High pressure engine—His first attempt was intended for a steam carriage in which he introduced the steam Cylinder supported upon Gudgeons near its center with the piston rod proceeding from it directly to the crank, so that as the crank moved round, the steam cylinder had a vibratory motion on its Gudgeons, and thus the necessity of any parallel motion to confine the piston rod to a straight line was done away. However, Mr. Trevithic did not continue to practice this mode, but designed his high pressure engines in various forms. In some a strong boiler of cast iron of the shape of a short glass bottle with a very rising concave bottom. The steam cylinder was fixed by a flanch to an opening in the boiler and the principal part of it, excepting the upper part where was the two wayed cock for the admission and exit of the steam to and from the bottom and top of the cylinder, was immersed in the Boiler, in the hot steam or water. In some cases the steam cylinder was placed horizontally with the connecting rod reaching from the piston to a crank and flywheel to drive machinery, but the most general form which these High Pressure Engines obtained (also called Trevithic engines) is shown by this drawing." [The drawing referred to shows the ordinary form of horizontal cast-iron return flue boiler with vertical cylinder immersed at one end.] "These engines were not yet, as far as I now recollect, immediately introduced for impelling Carriages on Rail Roads for drawing Coals &c."

THE Irish railway conciliation board met in Dublin for the first time on Monday last. In view of the delicate political situation and the evil that might result from any disturbance among the railwaymen, it is perhaps fortunate that Mr. J. H. Thomas has gone to Ireland to take charge of the men's case.

A Seven-Day Journal.

Electric Railways in South Africa.

The tendency to accept the Italian system of railway electrification as the model to be followed by South Africa may be partly a political manœuvre, but the statements made by Dr. William Macdonald on his return to Capetown after a visit to Italy appear to have made a great impression in South Africa. Dr. Macdonald has expressed the opinion that under the programme which has now been authorised Italy will possess the most efficient system of electric traction in the world, and one that if selected for South African railways would revolutionise the agricultural industry. The Engineer-in-Chief of the Italian State Railways has invited the Union Government to send electrical engineers to Italy to make an exhaustive investigation of the merits of the three-phase system. It will be recalled that the Union Government, on the advice of British engineers, has already decided to convert steam railways to electric traction on the direct-current system, and it is regarded as somewhat unlikely that there will now be any change of policy.

The Wages Problem.

The correspondence which has passed between Fodens Limited and the National Union of Foundry Workers throws light on an aspect of the labour problem which is causing anxiety to many employers. The moulders employed by this firm were quite willing some months ago to accept a reduction in wages suggested by the management, but in spite of this were ordered by the union officials to go on strike. The strike has continued until to-day. An application has now been made by a representative of the union for an interview with the directors of the company to discuss the situation in the light of the national wage settlement agreed upon between the engineering unions and the Engineering Employers' Federation. In a reply to the request for an interview, Mr. S. P. Twemlow directs attention to one or two facts which dominate the situation. He points out that his company gave plain warning a year ago of the effect of high wages, but that the National Union of Foundry Workers insisted on calling the men out. In declining the request for an interview, a reminder is given to the union officials that nothing could have saved the situation by which the country is now confronted except greater production at a rate which would make things as cheap as before the war. The only thing to do to-day is to take steps to reduce the wages cost in the sum of production, and the request for an interview to discuss the question of keeping up wages is dismissed as farcical. There is practically no work to be done, and no wages to be paid.

Notable New Liners.

An opportunity has just been presented of inspecting the Majestic, the mammoth liner being built for the White Star Company, which is claimed to be the largest ship in the world. The Majestic is now in the final stages of construction, and is expected to take her place in the Transatlantic service next spring. Features of the design and equipment are the fitting of anti-rolling tanks, as well as bilge keels and the installation of three separate wireless stations. Special attention has been given in the bulkhead arrangements to the results of recent research and official recommendations. The precautions against fire are of an elaborate character, and will enable whole sections of the ship to be isolated in the event of an outbreak. The ship will have a length overall of 956ft. and a beam of over 100ft. In the loaded condition she will be of over 60,000 tons displacement. She is designed for an average speed of 23 knots. These are figures which justify the claim that the Majestic will rank as the largest liner yet built. The feature of the Scythia, the new Cunarder, which left Liverpool on Saturday last on her maiden voyage to New York, is that she is the largest ship yet fitted with double reduction geared turbines. Other points in the equipment which possess interest for naval architects are the employment of the electro-hydraulic system for the operation of auxiliary machinery.

Carbon Monoxide in Gas.

Contrary to the expectation of many people, the Departmental Committee on Carbon Monoxide does not recommend any limitation in the proportion of carbon monoxide in domestic gas. The Committee has not, of course, ignored the risk from the poisonous nature of this content of domestic gas, particularly in water gas, which contains 42 per cent. of carbon monoxide against 7 per cent. in ordinary coal gas. It is not believed, however, that the increased risk will be found a serious one. The danger of increased death-rate is in any case of small dimensions, and against this must be set the certain improvement in the public health by the reduction of smoke and fog arising from increased use of gas. The evidence given has proved without doubt the economic advantages which follow the use of water gas, and the Committee was impressed by the necessity of allowing the development of the gas industry to proceed without any check on its natural progress. It is suggested, however, that the departments concerned should carefully watch the situation so that, if the freedom from limitation now recommended is accompanied by unexpectedly unfavourable results, the attention of Parliament may, if necessary, be again directed to the matter.

Persistence of Capital Ships.

The reports presented on the recent tests of the value of aircraft in attacks on battleships, which have been carried out by the United States Navy Board, indicate that the policy of building large surface-going warships is in the present stage of development of naval weapons a sound one. The aeroplane, instead of providing an economical instrument of war and leading the way to the abolition of the battleship, has merely, it is asserted, added to the complexity of naval warfare. It is recognised that in coast defence operations, aeroplanes may possess important strategical and tactical qualifications, and indeed in adequate numbers prove a decisive factor. The development of anti-aircraft armament and the equipment of fleets with numbers of pursuing aeroplanes borne in aircraft carriers, are considered by the Commission which has investigated the position definitely to limit the possibility of successful attack on fleets at sea by bombing aeroplanes or other types of aircraft.

Reopening of a Chemical Factory.

One effect of the prohibition of imports of salicylic acid is the reopening of the factory of the London Chemical Works, Limited, at Southall, which is to take place almost at once. Until German manufacturers commenced price-cutting tactics about a year ago this factory was in full operation, and was making a large output of sodium salicylate, for which the claim was made that it was purer than the German product. When the factory reopens, it is assumed that at the outset only salicylic acid will be produced. The situation with regard to sodium salicylate is still uncertain, doubts remaining if the duty which will be imposed under the powers granted by the Safeguarding of Industries Act is sufficient to prevent the dumping in the home market of the German product.

Wage Cuts Abroad.

While there is trouble in arranging for the necessary reductions of wages in Great Britain, it is reported that the United States Steel Corporation has determined on a 20 per cent. reduction of the wages of labourers. This step is stated by Judge Gary to be inevitable if manufacturers are to meet the position arising from a falling market for steel products. It is the third reduction made by the Corporation this year. In Germany wages are at a very low level. As long ago as December last skilled workers employed by Krupps were only receiving 4.40 marks per hour, which is equivalent to about 4d. in English money, and chemical workers about 6d. per hour. This low rate of wages when expressed in sterling is one explanation of the marked difference in price between English and German engineering products, and is proving a great advantage to the German manufacturer in his attack upon international trade.

Transport Ministry Economies.

Rumours which have been persistently circulated indicate the disappearance of most of the engineers from the Ministry of Transport. The Railways Bill having become law, there is a feeling in the air that the Ministry has now lost its principal occupation. The stories which are being told suggest that both the Mechanical Engineering and the Traffic Departments will disappear. Some of the occupants of the principal posts in these departments will doubtless be found positions elsewhere, and others in all probability will go back to their old railway jobs. Some, however, may be left stranded. In any event it appears as certain as it is appropriate that the economy axe which is to be placed in the hands of Sir Eric Geddes will be used in the first instance to cut down some of the main branches of the Ministry of Transport.

A German Tube Syndicate.

Tube combines were, in the years before the war, a common feature of the tube branch of the engineering trades. Both in Germany and in Great Britain associations of manufacturers attempted to control output and regulate prices. These combines had, however, a habit of breaking up after a certain period, and they were naturally not very popular outside the small groups concerned. It is now announced that the German manufacturers, who are more wedded to this kind of thing than British firms, are about to form a fresh tube trust. There has, it would seem, been an epidemic of price cutting both for domestic and foreign trade, and the market has sunk to a level at which it needs an artificial prop. This is to be supplied by a tube syndicate, the details of which are, it is said, being worked out by a committee. The preliminary step is to regulate output and to decide on the tonnage which can be allotted to the various firms who are to be partners. The only chance of a hitch is said to arise from the fact that some of the firms it is desired to bring into the combine are being financed by merchants whose point of view is naturally somewhat different from that of firms who are only interested in the manufacturing side. Our own tube firms are naturally watching developments.

Railway Standard Revenue.

The guarantee under the new Act of a standard revenue to railway companies raises a question which has been asked on many previous occasions. It has been suspected that the subsidiary undertakings of railway companies, like docks and harbours, hotels and steamships, are operated at the expense of the general undertaking, rather than with the idea of making a profit, and that the trader has to foot the bill. It is agreed that had the railway accounts shown the revenue of subsidiary undertakings separately the Railways Act would have provided that standard revenue should be the income derived from the railway undertaking alone. Business men were keen on this point and succeeded, on the initiative of the Federation of British Industries, in obtaining the acceptance by the Government of an amendment during the passage of the Bill through the House of Lords which gives practically all that was desired.

Engineers in Railway Shops.

The quarrel between the Amalgamated Engineering Union and the N.U.R. came to a head at the Trade Union Congress. It will be in mind that it was the National Union of Railwaymen which arranged the terms of employment of engineers engaged in railway workshops, the A.E.U. declining to be associated with the negotiations which led to a settlement of the points raised. The attitude of the railwaymen's union is that the A.E.U. people were wrong, and they are pressing for a review of the whole subject, so that pressure may be put on competing unions to act together in the conduct of negotiations. On the other hand, the A.E.U. executive contends that the trouble has arisen owing to the refusal of the railway union to give effect to a previous decision of the Trade Union Congress. All other labour organisations having railway shopmen as members have, it is said, fallen into line. This may be merely a storm in a teacup or it may reflect a state of things which deals a blow at the present trade union system.

Shipbuilders and the Bonuses.

As was anticipated, formal notice has been given of the discontinuance to shipyard workers from September 1st of the Ministry of Munitions bonuses of 12½ per cent. to time workers and 7½ per cent. to piece workers. This is the natural sequel to the official notification by Order in Council that from the legal standpoint the war is to be regarded as terminating on August 31st. Most people believe it ended long since. In acknowledging the receipt of the notice from the Engineering Employers' Federation, the Federation of Shipbuilding and Engineering Trades has assumed that the notice will not take effect until the subject has been discussed at a meeting of both sides. This meeting will, it is understood, take place early next month, but no discussion is likely to affect the decision now taken to discontinue the bonuses. Meanwhile an arbitration board is sitting in Glasgow to deal with the question whether certain bonuses granted during the war period to men engaged on standard ship construction shall be withdrawn. The branches of labour concerned are riveters, platers, shipwrights and blacksmiths. This, it will appear to most people, is a dispute which should have been settled without invoking the aid of arbitrators.

Mines in the North Sea.

Complaints are being received that the obligation laid upon Germany to sweep certain areas of the North Sea of mines is not being observed. Reports are coming to hand of a minefield in the vicinity of Esbjerg which has not yet been cleared, and which is proving a danger to navigation. The Danish Government has placed the facts before the British Admiralty, and Britain, who is not only Mistress of the Seas, but apparently regarded also as maid of all work, has been asked to take the sweeping of the area named under its control.

Developments in Power Station Design.

No. VI.*

Owing partly to the high price of coal and partly to the recent strike a great deal of attention has been paid of late to the question of burning oil fuel under power station boilers. Whilst the strike was in progress, many oil-burning equipments were put into use, but whether they will continue to operate regularly in the future or will merely be brought into service under abnormal conditions, remains to be seen. What will have a greater influence on future policy than anything else will, of course, be the cost, which, as everyone knows, has been in the past the main obstacle to the use of oil. The fuel and labour markets have altered to such an extent within recent years that a true comparison can now only be arrived at by careful consideration of the various factors, other than the actual price which is paid for the fuel —such as the available supply, heating value, labour, maintenance, control over fires, and storage. Due regard must be paid to calorific values and to the

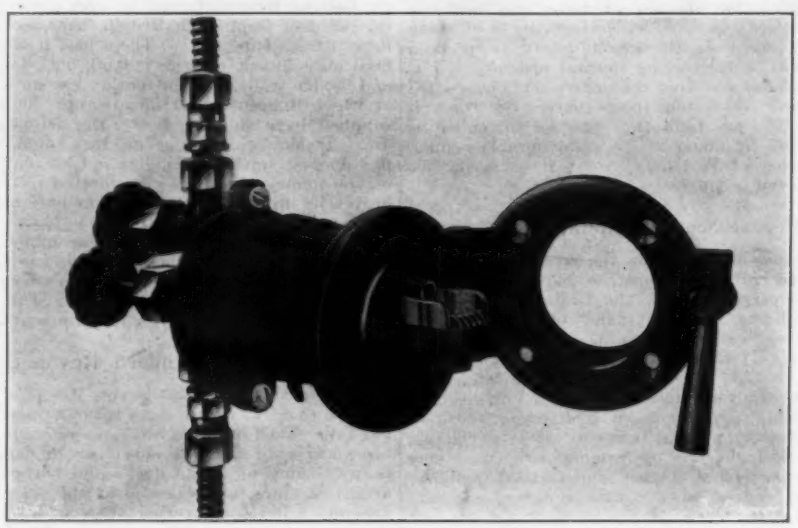


FIG. 16 - THE SCARAB OIL BURNER

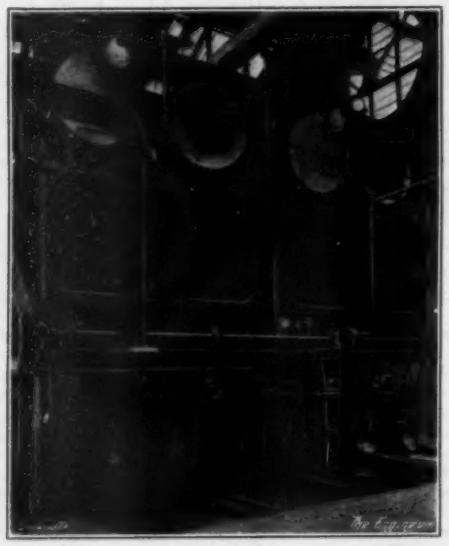


FIG. 17—BOILERS FITTED WITH SCARAB AND BABCOCK BURNERS

reduction in the cost of handling fuel, as with oil there are no ashes or clinkers to remove. Further, with oil fuel, boilers can be worked at higher rates and are more easily kept clean. In large power-houses the conversion of a few of the boilers to oil firing with a view to meeting peak loads is a matter well worth considering. Oil fuel is easy to handle, and is easily stored. The furnaces of an oil-fired boiler are at all times under perfect control, and the steaming capacity can readily be adjusted to suit any reasonable variations of load. One ton of oil fuel occupies 38 cubic feet, whilst a ton of coal occupies 45ft., so that weight for weight a saving of 15¼ per cent. in the storage space is obtained by the use of oil. But when the calorific value of the oil, as compared with that of coal, is taken into consideration, the saving in storage space for any specific work is over 50 percent. Oil stored in tanks can remain for years without deterioration, whereas coal exposed to the atmosphere suffers a material loss in calorific value. In comparing the relative values of oil fuel and coal, however, the most important factor on the side of oil is probably economy of labour, for pumps and pipes reduce mechanical labour to a minimum.

In burning oil fuel it is, of course, necessary to atomise it, so that it can be mixed with the quantity of air necessary for combustion. This is done by means of burners which may operate in accordance with three systems, known as the air jet, steam jet and pressure jet systems. For land boilers the steam jet system is often employed, owing, no doubt, to the great simplicity of the apparatus and to the absence of pressure pumps. It is claimed that with the Scarab system, which, as is well known, is a steam jet system, it is possible to evaporate as much as 15 lb. of water from and at a temperature of 212 deg. Fah. per pound of oil, having a calorific value of 18,500 British thermal units. Further, if desired, steam can be raised very much more rapidly than with coal. In the Scarab burner, which is shown in Fig. 16, the oil, which is controlled by a fine adjustment valve, flows by gravity through a tube on to the upper surface of the nozzle, and air or steam issuing from a fine aperture under the nozzle meets the oil at right angles as the oil flows over the lip of the nozzle. The makers assert that complete combustion is thus obtained, and the spray is directed into the furnace. A head of 3ft. or 4ft. is sufficient to enable the oil to run freely into the burner. The chief claims made for the Scarab burner, in addition to those already mentioned, are (1) the oil either in the form of a fluid or a spray does not pass through any restricted orifice, and consequently the liability of stoppages through carbonisation or dirt is eliminated; (2) as the atomisation is done outside the burner, combustion takes place at some distance from the nozzle, and no part of the equipment is subjected to intense heat, with the result that the burner does not deteriorate with use; (3) atomisation of the fuel is accomplished with equal efficiency from the full capacity of the burner down to 25 per cent. of the full capacity; and (4) the system is extremely simple. Steam or compressed air at a pressure of from 10 lb. to 15 lb. per square inch is used for atomising the oil, and in the case of land boilers the steam is taken from the boiler itself; but in that case, for starting up from cold, a connection must be run to another boiler already under steam or compressed air must be used. This air can either be taken from an existing compressed air main or from a small motor-driven air compressor. The illustration—Fig. 17—shows two boilers fitted with oil fuel burners of two distinct types. The right-hand boiler is fitted with Babcock and Wilcox burners, and the left-hand boiler Scarab burners. The general method of applying the Scarab burners to a Stirling boiler is shown in Fig. 18, where it will be observed that the fire-bars are covered with fire-bricks.

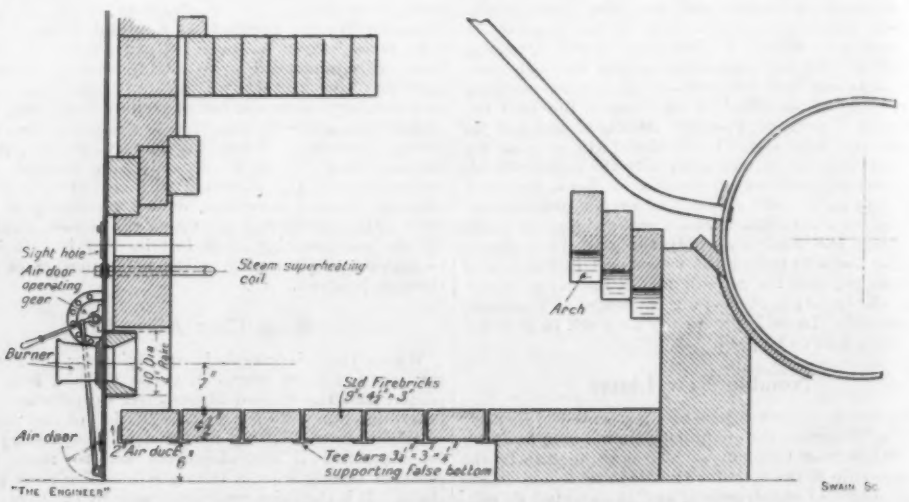


FIG. 18—SCARAB BURNER APPLIED TO STIRLING BOILER

For many years past Babcock and Wilcox boilers have been working with oil fuel, but the adoption of the system on land boilers was greatly increased during the coal strike. The company supplies equipments which work with steam, with compressed air or in accordance with the mechanical pressure system. Fig. 19 shows a Babcock and Wilcox boiler fitted with oil burners supplied with compressed air for atomising. When steam is used for this purpose, a certain percentage of the steam generated by the boiler is, of course, consumed by the burners, and in some instances, and especially in the case of marine work in which the waste of fresh water cannot be tolerated, the steam jet system cannot be used. In the compressed air system as applied to the Babcock boiler—as in Fig. 19

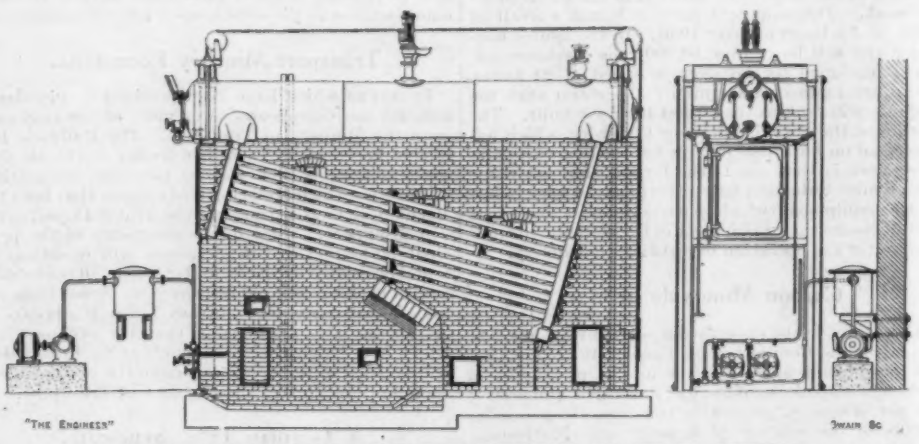


FIG. 19—BABCOCK BOILER FITTED WITH COMPRESSED AIR JET OIL BURNER

* No. V. appeared August 19th.

—a small motor-driven compressor is used for supplying the air for atomising the oil. With the Babcock mechanical system, the oil is pumped through the burners at considerable pressure, and in the burner it is caused to rotate very rapidly, while, as it emerges from the orifice of the burner the centrifugal force of the oil causes it to break up into a fine mist, which with the proper mixture of air can be burnt without smoke. The apparatus used for this mechanical or pressure system comprises (1) an oil pump to deliver the oil under pressure; (2) an oil filter to prevent particles of foreign matter from passing into the burners, and so interfering with the centrifugal action in breaking up the oil into a spray; and (3) a heater to make the oil sufficiently fluid for it to flow readily through the pipes and to facilitate the spraying action. With this pressure system the boiler efficiency is said to be higher than with the steam or compressed air systems. The Babcock steam burner will deliver up to 600 lb. of oil per hour and the pressure burner up to 900 lb. of oil per hour. The average amount of oil atomised would be about 250 lb. per burner of either type when working with a draught of from 0.5in. to 0.6in. water gauge at the boiler damper. The size of the burners can, however, be varied to meet the conditions of any particular case. The steam burner is shown in Fig. 20. Burners of this type can also be used with compressed air. The air register—which is shown in Fig. 21, and which is suitable for use with the steam jet or mechanical pressure system—is arranged so that the amount of opening for the admission of air can easily be regulated, and an impeller ring is provided to cause the air to mix thoroughly with the atomised oil, so as to ensure efficient combustion.

Where a complete and compact pumping and heating unit equipment is required for the mechanical pressure system, the Babcock pumping and heating set shown in Fig. 23 may be used with advantage. The unit is composed of duplicate steam-driven oil force pumps and duplicate heaters, together with the cold and hot filters, valves, &c., all mounted on a common bed-plate. Generally speaking, it is advisable to employ duplicate pumps and heaters, but the unit can be supplied if desired with two pumps and a single heater or a single pump and a single heater, or, alternatively, two single units, each comprising a single pump and single heater, can be provided. Single parts are also supplied separately to meet specified requirements. An interesting application of oil fuel to a Babcock boiler is shown in Fig. 22, where it will be perceived that chain grate stokers are fitted in the ordinary way, but at the side of the boiler three oil fuel burners are placed, so that the boiler can also be fired with oil. The burners work on the mechanical pressure system just described.

Oil is atomised by centrifugal force, as already mentioned, and the centrifugal action is produced by the pressure at which the oil is forced through the burner. The quantity of oil discharged varies with the pressure and with the dimensions of the burner, and the amount of oil that can be efficiently burnt by any boiler depends on the draught that is available. To provide for efficient combustion, the air is delivered through the burner mixer, which is designed to suit the conditions under which the draught is produced. The possible methods of creating the draught in the case of land installations are (1) by means of a chimney or induced draught fan, and (2) by means of a confined air duct. In the former case the air supply is delivered through a circular register fitted to the Babcock patented impeller ring, and when out of use the burner and air mixer can be swung out of their working position and a brick plug or a hinged frame is swung forward and made to close the opening. In the case of the second system, the arrangement of the air mixer is different and the air supply to each burner can be controlled, either by a circular grid or valves in the air main, or in the box containing the burner. It is important that the mixing cone should be correctly adjusted in relation to the opening in the brickwork and the burner disposed centrally. For satisfactory combustion the quantity of air supplied must be proportionate to the quantity of oil delivered by the burner. The oil is regulated by the oil pump pressure, which is controlled, according to requirements, by adjusting the escape valve on the pump, so that the oil pressure at the burners is adapted to the quantity of oil needed, any excess oil being released through the escape valve

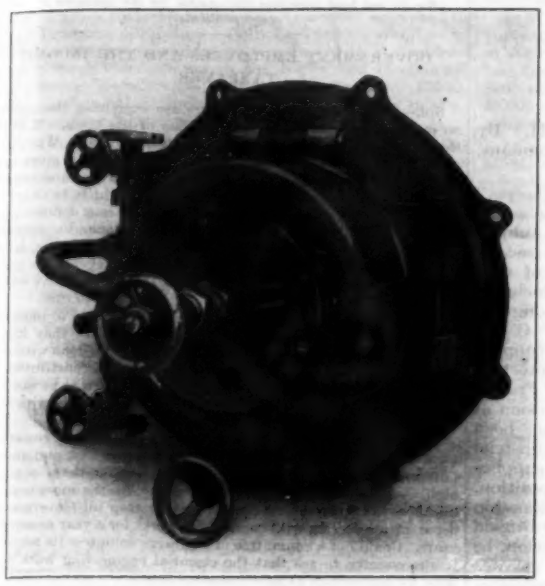
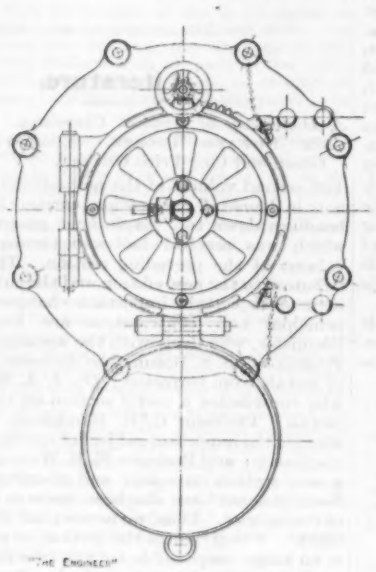


FIG. 20—BABCOCK OIL BURNER



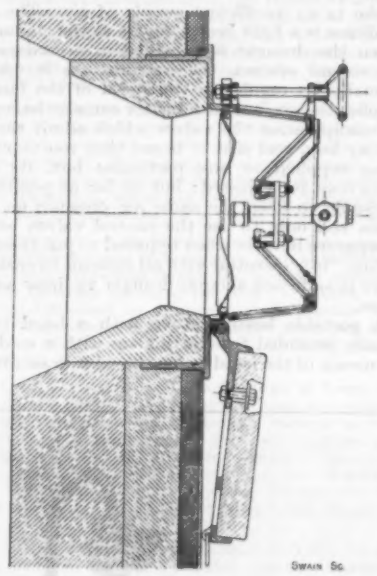


FIG. 21—AIR REGISTER

FIG. 22—BABCOCK BOILER FITTED WITH CHAIN-GRATE STOKERS AND OIL FUEL BURNERS

on the pump, and returned to the pump suction. It is desirable that all the burners should be worked with the same oil pressure, and normally the control valves on the burners should be kept wide open, and the air vessel on the discharge side of the pump should be kept fully charged with air to ensure the maintenance of the steadiest possible oil pressure. In the case of system 1 referred to above, the quantity of air is regulated by adjusting the air opening in the register by means of gearing to be seen in Fig. 21. White smoke or an entire absence of smoke at the chimney points to excess air and loss of economy, and black smoke to an insufficient supply of air. The correct condition is a light brown smoke at the chimney top. When the draught is provided in accordance with the second system, the air pressure is controlled normally by regulating the speed of the fan which supplies the air, but each burner can also be regulated by manipulating the valves which admit the air to the air box, and if it is found that too much air is being supplied to any particular box, its control valve may be adjusted; but as far as possible it is advisable to keep the same air pressure on all the boxes and only to use the control valves belonging to separate burners when required to put them out of action. It is essential with all systems to ensure that there is sufficient suction draught to draw away the gases.

A portable heating stove with a hand pump is usually provided for starting up with a cold boiler. By means of the hand pump the oil is drawn from the

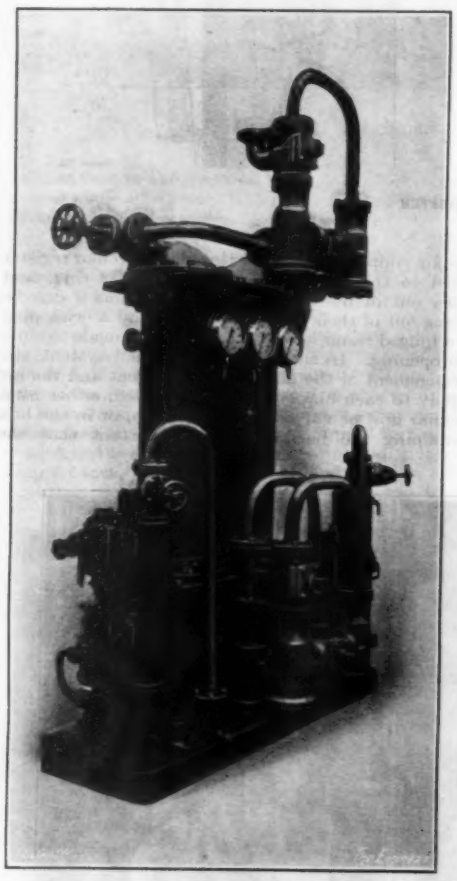


FIG. 23—BABCOCK OIL PUMPING AND HEATING UNIT

oil delivery pipe and passed through the heating stove, and then back again through the oil delivery pipe to the burners. As soon as there is sufficient steam, the hand pump is stopped and the main pump and steam heaters are started. The temperature to which the oil should be heated depends on the nature of the oil. Heavy grade and thick oils require a higher temperature than light oils, and as a rule the temperature of the latter need not be raised above 150 deg Fah. Some light oils will burn without any heating at all. Some of the tar oils, on the other hand, have to be heated to more than 200 deg. Fah. Unless the oil is delivered through the burner at the correct temperature spraying is unsatisfactory. Too high a temperature causes vibration in the furnace and carbon deposit in the pipes, whilst too low a temperature produces heavy smoke and imperfect combustion. The filters referred to earlier are attached to each heater at the inlet and at the outlet, and whilst one filter is being cleaned the other can remain in use. Pressure gauges are fitted on the inlet and on the discharge side of the filter system, and the difference in the readings of these gauges indicates when the filters require cleaning. When lighting up one or more of the burners may be started, as necessary, by placing a torch, consisting of asbestos fibre twisted round a steel rod and soaked in paraffin or oil, in front of the burner. When the torch is well alight, the control valve of the burner is carefully opened so as to allow the oil spray to strike on the flame of the torch. The spray then ignites and the torch is withdrawn. The smoke is then noted and the air register doors are adjusted as required. If at any time the burners go out, the control valve is immediately shut off, so as to prevent liquid oil gaining access to the combustion chamber. The oil can again be ignited with the aid of the torch in the manner described. In certain cases and where the oil is suitable, a central spindle is fitted to the burners to enable the oil used for raising steam to be burnt cold, and the stoves referred to are then unnecessary. A special small burner is sometimes provided for use temporarily when lighting up.

Literature.

A Dictionary of Applied Chemistry. Vol. II. By Sir EDWARD THORPE. London: Longmans, Green and Co. Price 60s. net.

THE second volume of the new edition of "Thorpe," now in course of publication, carries the alphabetical headings down to "Explosions, gaseous," a subject which was reached half-way through the second volume of the preceding edition. The list of contributors to the new edition and the subjects included in it show certain important changes. Among the principal new contributors are Professor C. O. Bannister, who deals with the metallurgy of copper; Professor J. S. S. Braun, who discusses the protection of metals from corrosion; Dr. J. A. Newton Friend, who contributes a useful section on the corrosion of metals; Professor G. G. Henderson, who has been allotted the important subject of catalysis in industrial chemistry; and Professor E. R. Watson, who supplies a new section on colour and chemical composition. Some changes have also been made in the authorship of the articles. Thus, we notice that while Sir Dugald Clerk still contributes the section on evaporation, he is no longer responsible for the treatment of gaseous explosions, a subject now dealt with by Professors W. A. Bone and R. V. Wheeler.

It is, or should be, unnecessary to say at this date that Thorpe's Dictionary is almost as valuable to engineers as to chemists. It presents a survey of the material universe and of the uses to which man puts nature's materials, and whether we regard it merely as a work of reference or as a means of extending our general knowledge, we cannot fail to recognise and appreciate its value. Other works of a similar nature there are, but "Thorpe" stands easily at their head, at least of those in the English tongue.

SHORT NOTICES.

Hydraulic Forging. By Clifford O. Bower. London: The Library Press, Limited, 26, Portugal-street, W.C.—This book was first issued in 1919 under the title of "Practical Shell Forging." It still takes the high explosive shell as the typical product, but the information which it contains is far from being restricted in value to the very few people now interested in shell forging. Our knowledge of hydraulic forging was undoubtedly greatly extended during the war. The needs of the times likewise led to a rapid extension in the number of forging presses in the country. These presses are still mostly in existence and are being applied to the production of useful commercial objects. Mr. Bower is well qualified to act as a guide in assisting others to take full advantage of hydraulic forging presses, for, as the late assistant manager of Armstrong, Whitworth's ammunition department and previously of the like department at Vickers' works, he has had many years' experience of the subject. His book is thoroughly practical, fully illustrated, and clearly written. It pays sufficient attention to the theoretical side of the matter without being overburdened with considerations of purely scientific interest.

Modern Motor Car Practice. By W. H. Berry. London: Henry Froude and Hodder and Stoughton. Price 31s. 6d. net.—This book, edited by Mr. Berry and contributed to by numerous well-known authorities, forms a valuable record of contemporary motor car practice. The progress made in the automobile branch of engineering during the war was, in spite of all that was at one time hoped of it, not such as to produce any really radical changes in the design of motor cars. In fact, the cars of 1921 are simply the 1914 designs greatly improved in their details. The prophecies and promises of 1919 have not been fulfilled. Hence it comes that Mr. Berry's book, begun some two years ago, records less revolutionary progress than its author apparently expected it would do when he first planned it. Nevertheless, it was a work well worth undertaking, particularly as Mr. Berry has sought to treat his subject in a very thorough manner—too thorough, perhaps, for the tastes of the average motor car owner, but admirably suited to the needs of the serious student of car design. The historical element is usefully introduced, and throughout both the text and the illustrations there are practically no signs of advertisement, the almost universal bane of all books dealing with motor cars.

Centrifugal Pumps. By J. W. Cameron. London: Scott, Greenwood and Son. Price 12s. 6d. net.—In the belief that the time is not far distant when the centrifugal or turbine pump shall have completely displaced the reciprocating type, the author of this book has endeavoured to provide a guide to the design of pumps of the first-named class. The treatment accorded the subject is in part theoretical and in part descriptive of current practice. The author has evidently sought to keep his work within small dimensions—a laudable endeavour in these days. Were we not in full sympathy with him in this respect we should feel inclined to criticise the small scale on which some of the important drawings and diagrams have been reproduced and the limited range of firms—one American, one Swiss and one British—whose products he has chosen for description. On the whole the book appeals to us as likely to be of considerable practical value to pump designers.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

GOVERNMENT EMPLOYEES AND THE INCOME TAXPAYER.

SIR,—Almost all the daily papers are exercising themselves on methods and plans for the reduction of the taxes. Most of them cry for the staffs of the Government offices at Whitehall to be reduced, and also protest against the war bonus given and still paid. They do not particularise as to which men and women should go, nor do they insist that the bonus ought to be dropped universally at once. There is no one who takes a definite line, as Gladstone or John Bright would have done, to suppress certain offices or discharge certain men. They all agree, however, that the income tax of 6s. in the pound prevents the engineering and other industries from keeping their heads above water and generally that the tax is bringing the country to ruin.

The question arises as to what engineers could do to improve the finances of the country. In engineering work they know what is really required and what can very well be done without. Is it possible that a committee of engineers—self-constituted, if necessary—could collect any evidence which it knew to be worthy of credence, and come to conclusions on such evidence with the object of bringing about a better state of things?

It might, for example, make a list of the kind of engineering work which the Government orders or takes in hand, and ascertain whether it was absolutely necessary while taxes are so high, and whether the work was done in the most economical way. Suppose it were decided to stop all Government departments dealing with engineering works for a year or several years. Could not a committee of engineers volunteer its services to the country to see that the essential engineering work was done by contractors at an economical rate?

A few weeks ago some high-placed official at the Office of Works had an attack of nerves and ordered guards to be made for the windows of the Home Office. They were stiffened at the corners with angle irons and each of them was riveted to the frame with four ⅞in. rivets. Each of the four corners of the frame had an angle iron so that there were sixteen rivets put into a frame and riveted cold. Seven vertical bars ⅞in. diameter were fitted in the frame. The top and bottom plates of the frame were drilled ⅞in. and the round bars were fitted in and riveted over at the ends. The whole frame, cutting, fitting and riveting, took about seven hours to make. The riveting took less than two hours. One of the frames was taken down to Whitehall so that the Office of Works men might help in getting it through quickly. Being highly skilled and very highly paid, it was intended that they should get the window guard through very quickly indeed. Before being dispatched the guard had been cut, fitted, all holes drilled and rivets tried in holes; everything done but the riveting together. The time sheets of the Whitehall experts showed that the latter spent twelve hours on the riveting alone, though the "inferior" skilled man of the outside contractor could completely finish a window guard in from five and a-half to seven hours. At that rate the Whitehall men would have taken a whole week or more to have completely made a window guard. As the pay of the two men engaged on the work was 4s. 8d. an hour, the cost of the window guard in labour alone would have been £10 19s. 4d., which was much more than the contract price for supplying labour and material too. On being questioned, the foreman said, "We pay our men." But, of course, it is not the foremen or the Office of Works who pays for such men and such waste. It is the poor man who is saddled with 6s. in the pound income tax. Yourself and I and the contractor pay for such work and such workmen. Inquiry amongst Government workmen established the fact that such rate of working was not abnormal. It was the rule. It might be in some cases slower, but it was never faster.

Well now, Mr. Editor, your committee, sitting in the interests of the trade which pays 6s. in the pound income tax, would raise the question whether the luxury of a directly employed Government workman was worth it. If this is a sample—and it is a sample—in favour of the workman, would the committee not be justified in recommending that the directly employed system should be scrapped? Would it not also recommend that the nervous official should have extended leave to the seaside, where he could play with the limpets on the rocks, recover his health, and get to work in some contractor's office?

Well, anyway, a committee which would ask for time sheets of Government employees, examine them, and report, would be very useful at present. G. HALLIDAY.

August 23rd.

JUBILEE OF THE JAPANESE GOVERNMENT RAILWAYS.

SIR,—May I crave the hospitality of your columns in an endeavour to collect whatever information I can for the purpose of the above-named jubilee?

The Chairman of the Committee of the Government Railways Jubilee, writing recently to me from Tokio, makes the following request:—

"The Japanese Government Railways are going to celebrate the fiftieth anniversary of their inception in October this year. In connection with this, we shall be much obliged if you will kindly let us know the name, address, and brief record of career of any British subjects who came over to Japan to serve on our railways and are still alive."

Fifty years is a large span in the career of the active man, but should this request arrest the attention of any reader who went to Japan to assist at the birth of the Japanese railways I should be greatly obliged if he would communicate with Mr. U. Beppu, the Chairman of the Jubilee Committee, or with me, as acting for the Committee. GEO. CAWLEY.

82, Victoria-street, London, S.W. 1,
August 23rd.

Railway Matters.

Among the Bills which received the Royal Assent on the 19th inst. were the Railways Bill and the Irish Railways (Settlement of Claims) Bill.

A start has been made on the reconstruction of Belfast Corporation tramway lines, and it is expected that the work will extend over two years. Ex-service men, of at least twelve months' residence in the city, are to be employed for the work.

On August 15th the Minister of Transport answered in the affirmative a question by Mr. Lockyer-Lampson as to whether economies could now be effected in the salaries of the three chief officers in the traffic and mechanical engineering departments, viz., director-general £3000, chief mechanical engineer £2500, and consulting mechanical engineer (part-time) £2500.

A Reuter's dispatch from Adelaide states that the Commonwealth Government has decided to obtain the services of an expert of the widest possible experience in either England, America or Australia to take supreme control of the railways of the various States. Here, it seems to us, is an opening for one of the British officers to be displaced under the Railways Act.

The new Railway Rates Tribunal to be set up under the Railways Bill is a distinct body from the Rates Advisory Committee. It will, however, have the same chairman—Sir Frank Gore-Browne, K.C.—or perhaps we ought to say the present chairman of the Advisory Committee is to be the chairman of the Tribunal. The two other members of the latter body have not yet been elected.

When the Railways Bill was issued we noticed that the King's Lynn Docks and Railway was not included in the schedule, although it is not a light railway. The explanation for its omission was given by Lord Lytton in Committee in the House of Lords, who said that it was really a dock company, with a number of sidings and a line about a mile long connecting up with the Great Eastern Railway

It is rumoured that the railway companies intend to reimpose the charge of 1d. made to cabmen who use a station for the purpose of hire. There was some trouble as to this during control, but the Government, being in "possession" of the railways, had the payment stopped. The companies claim that the small charge gives them a control over the cabs which take passengers away. On the other hand, they owe to their patrons that there should be a sufficient supply of cabs.

We regret to have to announce the death on the 7th instant of M. Louis Weissenbruch, one of the engineers of the Belgian State Railway, but better known the world over as the general secretary of the International Railway Association, and the editor of the Association's *Bulletin*. Monsieur Weissenbruch had been connected with the Association since the inaugural meeting in 1886, when he was made the assistant secretary. He was a prolific writer on signalling and safety on the railways.

Now that the railways are decontrolled, the Railway Clearing House resumes its former activities, so that each company gets its share of all through tickets and through rates. When the companies had their receipts guaranteed, this was immaterial, and no returns of bookings or consignments to foreign lines were sent to the Clearing House. In view of the approach of decontrol, the companies resumed the returns in April last so that their staff and the Clearing House could get used to them.

For the railway companies to have resumed week-end bookings and some of the excursion fares is not so magnanimous as it may seem. The former are at a single fare and one-third for the double journey, and the latter are about—never less than—the single fare; moreover, the single fare is now 75 per cent. above pre-war level. A benefit the companies gain by having nothing cheaper than the single fare for the double journey is that no one can now profit by going to his destination by an excursion and sacrificing the return half.

According to the statement issued on August 19th by the Ministry of Transport, the railways had larger passenger receipts in June—the last month of the coal dispute—than in April or May, whilst the goods receipts were better than in May. The expenditure was slightly less than in April, but much greater than in May. Thus, as compared with the expenditure exceeding the revenue by £345 294 in March, the excess in April was £5,494,976, in May £4,846,840, and in June £5,718,680. On "other businesses" there has also been a loss, so it would seem that the total loss to the railways by the coal dispute was £17,281,418.

To the list of high-voltage direct-current railway electrifications already in successful operation is soon to be added the Paulista Railway of Brazil. The substitution of electricity for steam as motive power on this road is being made first on the division between Jundiahy and Campinas, a double-track section 45 kiloms. (28 miles) in length. However, the immediate plans of the company contemplate the extension of this electrification over the adjoining division from Campinas to Cordeiro, a distance of 72 kiloms. (45 miles), making a total of 117 kiloms. (73 miles). All the apparatus and equipment is of such design and capacity as to be suitable for operating over the probable continuation of the electrification to Sao Carlos, an overall distance of 206 kiloms. (128 miles).

In pre-war days the branch of the Railway Department of the Board of Trade which held inquiries into accidents to railway servants consisted of two assistant inspecting officers and three sub-inspecting officers. For some time now there have been only one assistant, Mr. J. P. S. Main, and two sub-inspectors. The work has therefore suffered, and in 1919 there were but 355 inquiries as compared with 871 in 1913. The situation will now be improved by the appointment of Mr. William Worthy Cooke, a London and North-Western driver, as a sub-inspector. Mr Cooke has been an active member of the executive of the Associated Society of Locomotive Engineers and Firemen, and has been its President. In 1911 he gave evidence before the Royal Commission on Railway Conciliation Boards.

Notes and Memoranda.

The output of coal for the week ended August 7th was 3,619,000 tons, as compared with 4,587,300 tons in the previous week and 3,086,700 tons in the corresponding week of 1920.

As a result of recent experiments, a professor of science at Toulouse claims that the time may come when petrol and benzol will be supplemented, and perhaps replaced, by a synthetic combination of vegetable oils.

It is stated that the number of cars in circulation in Holland is estimated to be between 8000 and 9000; but, in view of the fact that last year, out of a total of 6000 cars imported into Holland from all parts of the world, 3000 alone came from the United States, an estimate of 10,000 cars in use in Holland would probably prove to be more correct.

In a paper read before the Academie des Sciences, M. Mailhe described a process for manufacturing motor spirit from linseed and other vegetable oils by passing the vegetable oils over a special apparatus which deprives the oil of its water and hydrogen. The resultant volatile product is then passed over nickel, and M. Mailhe claims that it is then in all respects similar to petrol.

The first radio-controlled motor car has appeared in the streets of Dayton, Ohio, according to the *New York Herald*. No one was in the car—to all appearances a conventional one, 8ft. long—yet it made its way through the main streets, obeying the traffic signals, taking the turns, and blowing its own horn at careless pedestrians. The car was driven by its inventor, Captain R. E. Vaughan, from another car following it at a distance of 17 yards or so.

From a series of tests on large coil springs, carried out in accordance with the magnetic induction method, it has been found during the past year that magnetic retentivity gives a satisfactory indication of the hardness of the springs. The figures compared favourably with those obtained from micrographic and Brinell hardness examinations of the pieces. Details of the tests were given recently by the investigators before the American Society for Testing Materials.

According to the *Journal* of the American Institute of Electrical Engineers, certain tests, carried out in order to determine the rupturing capacity of oil circuit breakers, have shown that reactances in the circuit, while reducing the maximum current, may subject circuit breakers to additional strains by tending to prevent the circuit from being interrupted at the zero value of current, which is the point at which a circuit breaker usually interrupts the circuit in the absence of reactance.

Addressing a meeting of Bradford wool textile manufacturers recently, Mr. H. W. Massey, Prime Minister of New Zealand, referred to the up-to-date sheep and dairy farms in New Zealand, and spoke of the increasing use of electrical power on such farms. He said he fancied they were rather more up-to-date in New Zealand than in the Homeland. They were going to provide electricity for motive power purposes for practically every industry in the country. They were developing their water powers to deal with this, and he believed that within five years every dairy farm in New Zealand having over a dozen cows would have its machinery driven by electricity.

In future, states a well-known boiler expert, there should be a great development in the use of surplus and waste heat in power stations. There are several large plants using surplus gas with a calorific value of 450 B.Th.U. per cubic foot. In Newcastle such gas has been brought some distance and burned under water-tube boilers with an efficiency of 79 per cent. The engineer of a large plant in India hopes by this means to achieve an evaporation of 100,000 lb. per hour. With blast-furnace gas, efficiencies up to 77 per cent. will doubtless be obtained. As a rule 50 per cent. of such gas is available for steam-raising. Where a large number of blast-furnaces are centralised, there are great possibilities for local power stations such as already exist in the Lorraine district.

Eight years after its appointment, the Departmental Committee on Spontaneous Combustion of Coal in Mines has now issued its final report. It presented an interim report, however, in December, 1913, and afterwards its work was interrupted by the war. The present report, according to *The Times*, states that probably all bituminous coal is liable to spontaneous combustion in some degree, but that there is greater liability to self-heating of the coal in the seams of some British coalfields than in others. This is due to causes other than the chemical composition of the coal. The thicker the seam, the greater, in general, is the liability to spontaneous combustion; the coal which has been crushed in the mine by reason of superincumbent weight is more liable to self-heating than coal in a solid, compact state. As regards systems of working, it is declared to be impossible to lay down any hard-and-fast rule for universal application. No regulations are recommended additional to those brought into force in July last.

It is reported that there has been a great demand recently at the National Physical Laboratory for tests on ball and roller bearings, chiefly as regards their maximum running loads. The machine used for this purpose has been kept continuously in use. The speed at which tests have been made has not been very high—about 1300 to 1500 revolutions per minute—and at this speed it seems that a ball bearing, as made by one of the many recognised manufacturers, will not fail until the shaft which it supports is dangerously loaded. It has not been found possible at present to damage a roller bearing to any serious extent. The tests show that ball and roller bearings properly mounted and protected from moisture or dirt are efficient under high loads, and it is possible that the ordinary running loads adopted are smaller than necessary. One interesting observation that has been made upon several different makes of both ball and roller bearings is that a few hours running at the nominal maximum loading reduced the friction observed on subsequent running at lower loads. This reduction amounts to 10 or 15 per cent. Whether this is always the case or not we have not sufficient evidence at present.

Miscellanea.

It is announced that the Secretary of State has accepted the recommendation of the Government of India for the carrying out of the Sukkur barrage scheme.

The Air Ministry announces that the service stations at Blandford, East Fortune (buildings) and Barlow have been relinquished or passed for disposal.

The number of radio stations operated and controlled in the Australian Commonwealth was recently stated by the Minister of Defence to be twenty, exclusive of naval stations at Garden Island, Jervis Bay (N.S.W.), and Williamstown. In addition to the Commonwealth stations, there are eight under the jurisdiction of the Administrator of the New Guinea territory.

It is stated that the Polish Government has made a contract with the Radio Corporation of America for the construction of a three million-dollar high-power radio station at Warsaw, having direct connection with Rocky Point, Long Island. It is understood that the Polish Government will own the station, which will be operated in conjunction with the Radio Corporation for a period of thirty years.

From the report of the Chief Inspector of Factories and Workshops for the year 1920 we learn that, notwithstanding the trade depression during the year, the number of registered factories increased by 4610 to 140,064, while workshops continued to disappear, their number being 141,971. The total number of persons employed in all factories in 1919 was 6,127,706—*i.e.*, 2,157,783 females and 3,969,923 males.

The Local Government of the Province of Liége, Belgium, has been closely considering how best to re-organise its existing and projected generating stations in order that the electrification of the Province may be most advantageously effected. In order to assist in the solution of this problem it is offering four prizes, one of 25,000f., one of 15,000f., and two of 10,000f., for the four best schemes which may be submitted on or before March 1st, 1922.

The Heston and Isleworth District Council, in conjunction with the borough of Ealing, recently decided to submit to the Electricity Commissioners a scheme for establishing a new power station for the combined districts near the Duke of Northumberland's residence on the banks of the Thames. The total area of the district is about 9000 acres. The assessments are nearly £1,000,000. The present generating stations are very inconveniently placed, and sanction for the extension of these stations could not be obtained from the Commissioners.

One of the minor results of the war has been that the German telegraphic lines are either in a bad state of repair or completely out of service. In consequence of this and of the growing commercial demands the Telegraph Department has erected a considerable number of medium power radio stations designed to replace in part the imperfections of the wire telegraph system. At the present time these stations are handling considerable traffic. Several of them operate on continuous waves using valve oscillation generators working on wave lengths between 900 m. and 2500 m.

A new motor lifeboat has just been completed by the Royal National Lifeboat Institution for its station at Wexford in Ireland. She is a Watson boat, 45ft. long by 12ft. 6in. beam, and she is fitted with a Tylor engine developing 60 horse-power. The vessel was built with money provided by a bequest of the late Mr. William Evans, of Wolverhampton. She left Cowes on August 14th and reached her station some few days later, having made the journey of 380 miles under her own power. Five motor lifeboats have now gone to their stations this year, making a total of thirty now on the coast. Another thirteen are under construction.

A scheme designed to give Manchester engineering students practical experience in the city engineer's department was considered by the Town Hall Committee on August 10th. It was proposed that two or three suitably qualified men should be taken on for a two years' course, during which they would pass through the drawing-office and take part in work on roads, bridges, walls, sewers and surveying. They would not be paid, but would be given a certificate at the end of the course. The proposal is, of course, applicable to every technical department, and the Town Hall Committee, which approved the scheme, has invited opinions from the other departments of the Corporation.

In reply to questions, the Assistant Postmaster-General (Mr. Pike Pease) stated in the House of Commons recently that the technical advisers of the Post Office were satisfied that the type of aerial equipment at the Leafield wireless station was suitable for the purpose for which it was intended. The transmitting apparatus at the station consisted of two 250-kilowatt arc installations, and was similar to the arc equipment installed at the French station at Lyons. The Post Office intended to continue the erection of a wireless station at Northolt, which was planned within the last twelve months, and he was advised that the wireless equipment embodied all the latest improvements. The station would be operated on the continuous wave system.

Although cold storage owes much of its success to the researches and experiments of French scientists, it has received far less practical application in France than elsewhere, principally because that country is to a large extent self-supporting, and before the war there was no necessity to provide for the storage of large quantities of perishable foodstuffs imported from abroad. The absence of such storage facilities caused considerable inconvenience when, both during and after hostilities, the country was obliged to purchase nearly the whole of its foodstuffs abroad, and arrangements were therefore made to lay down cold storage plants, of which one of the most important was recently put in service by the Orleans Railway Company in Paris. A large number of cold storage wagons have recently been purchased in England and the United States, which has given rise to some complaint amongst wagon builders, who affirm that they are quite capable of supplying such vehicles themselves.

LIFT-LOCKS ON THE CANAL DU CENTRE IN BELGIUM

(*For description see page 2 8*)

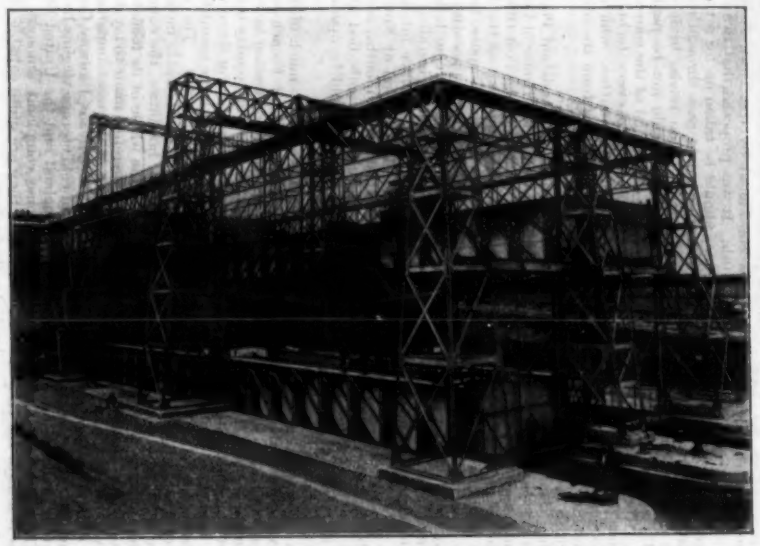


FIG. 8—LOCK No. 1 AT LA LOUVIERE

FIG. 9—HYDRAULIC RAM SUPPORTING RISING BASIN

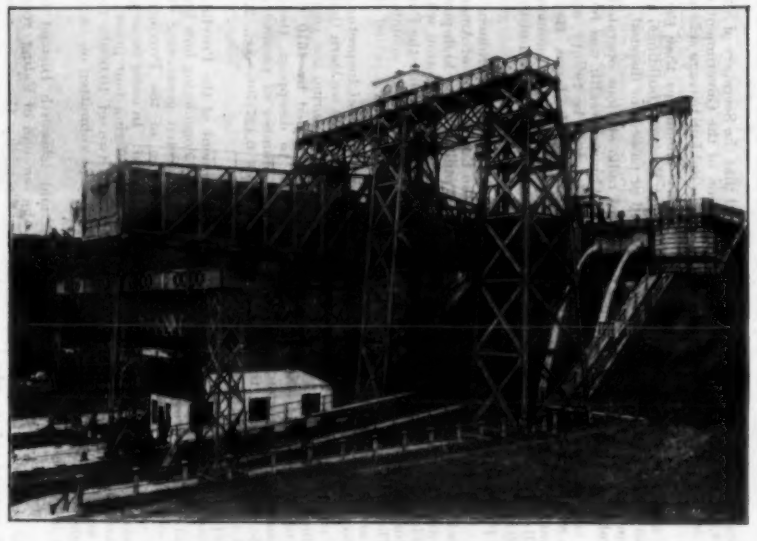


FIG. 10—LOCK No. 2 AT HOUDENG-AIMERIES

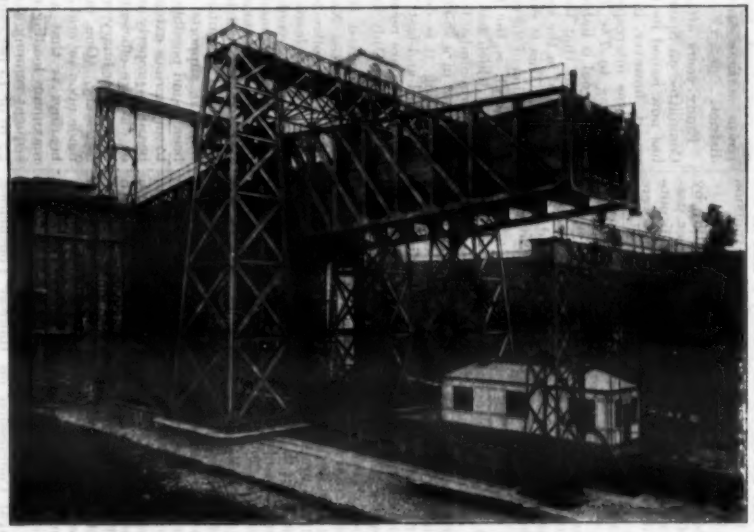


FIG. 11—LOCK No. 3 AT BRACQUEGNIES

FIG. 12—WATERTIGHT DOOR ON UPPER CANAL

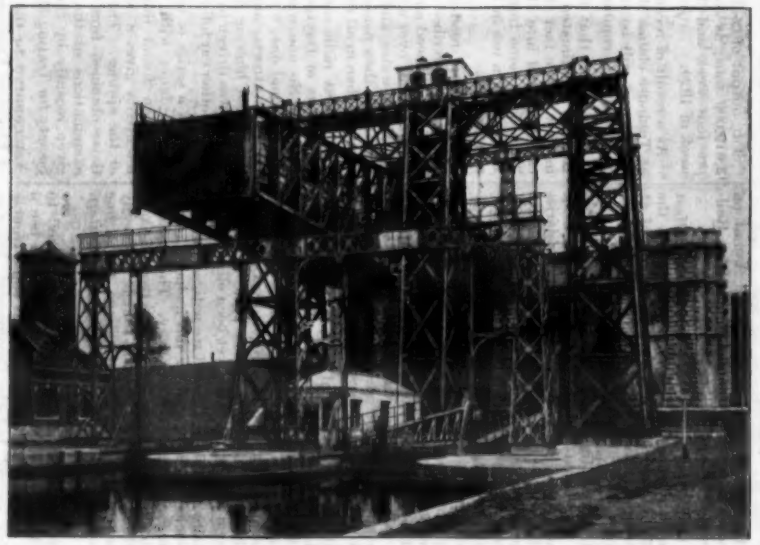


FIG. 13—LOCK No. 4 AT THIEU

AGENTS ABROAD FOR THE SALE OF

The Engineer.

BUENOS AIRES.—Mitchell's Book Store, 576, Cangallo.
CHINA.—Kelly and Walsh, Limited, Shanghai and Hong Kong.
EGYPT.—Cairo Express Agency, near Shepheard's Hotel, Cairo.
FRANCE.—Boyveau and Chevillet, Rue de la Banque, Paris. Chapelot and Cie., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. Smith and Son, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. Combridge and Co., Bombay; Thacker and Co., Limited, Bombay; Thacker, Spink and Co., Calcutta.
ITALY.—Maglioni and Strini, 307, Corso, Rome; Fratelli Treves Corso Umbarto I, 174, Rome; Fratelli Bocca, Rome; Ulrico Hoepli, Milan.
JAPAN.—Maruzen Co., Tokyo and Yokohama.
AFRICA.—Wm. Dawson and Sons, Limited, 7, Sea-street (Box 49), Capetown.
C. Juta and Co., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—Gordon and Gotch, Limited, Melbourne, Sydney, Brisbane, and Perth, &c.
Melville and Mullen, Melbourne.
Atkinson and Co., Gresham-street, Adelaide.
CANADA.—Dawson, Wm., and Sons, Limited, 87, Queen-street, East, Toronto.
Gordon and Gotch, Limited, 132, Bay-street, Toronto.
Montreal News Co., 386-388, S. James-street, Montreal.
Toronto News Co., 42, Yonge-street, Toronto.
CEYLON.—Wijayartna and Co., Colombo.
JAMAICA.—Educational Supply Co., Kingston.
NEW ZEALAND.—Gordon and Gotch, Limited, Wellington and Christchurch; Upton and Co., Auckland; J. Wilson Craig and Co., Napier.
STRAITS SETTLEMENTS.—Kelly and Walsh, Limited, Singapore.
UNITED STATES OF AMERICA.—International News Co., 83 and 85, Duane-street, New York; Subscription News Co., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—British and Colonial Press, Inc., 736, The Knickerbocker Building, 152, West 42nd-street, New York City.
FRANCE.—Agence Vox, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. Smith and Son, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SOUTH AMERICAN BRANCH OFFICE OF

The Engineer.

526, Bolsa de Comercio, Buenos Aires.

SUBSCRIPTIONS.

The Engineer can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number)	£1 12s. 6d.
Yearly (including two index numbers)	£3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive The Engineer weekly and post free. Subscriptions sent by Post Office Order must be made payable to The Engineer and accompanied by letter of advice to the Publisher.

Thin Paper Copies.		Thick Paper Copies.	
Half-yearly	£1 11s. 6d.	Half-yearly	£1 13s. 9d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage).

Canadian Subscriptions—

Thin paper edition	£2 18s. 6d. per annum.
Thick paper edition	£3 3s. 0d. ,,

ADVERTISEMENTS.

*** The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "The Engineer Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of The Engineer.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** *If any Subscriber abroad should receive* The Engineer *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

The Engineer, August 26th, 1921.

	Page
The Effect of Appendages in Ship Resistance. (Illustrated.)	207
Lift Locks on the Canal du Centre, Belgium. (Illus.)	208
Water Power Developments in North Wales. (Illus.)	210
Notes on Trevithick's Locomotives	211
A Seven-day Journal	213
Developments in Power Station Design.—No. VI. (Illus.)	214
Literature	216
Letters to the Editor—	
Government Employees and the Income Taxpayer	216
Jubilee of the Japanese Government Railways	216
Railway Matters	217
Notes and Memoranda	217
Miscellanea	217
Leading Articles—	
The Airship Disaster	219
Battery Vehicles	219
Elongation and Gauge Length in Tensile Tests. (Illus.)	220
Obituary—	
Sir Samuel C. Davidson	221
Robert Somerville	221
200 H.P. Uniflow Steam Engine. (Illustrated.)	222
Vacuum Pump for Corrosive Gases. (Illustrated.)	224
Safety Tanks for Aircraft	224
Swedish Electric Power Scheme	224
Provincial Letters—	
The Midlands and Staffordshire	225
Lancashire	225
Sheffield	226
North of England	226
Scotland	227
Wales and Adjoining Counties	227
Latest News from the Provinces	227
Current Prices for Metals and Fuels	228
French Engineering Notes	229
British Patent Specifications. (Illustrated.)	229
Forthcoming Engagements	230
Educational Intelligence	230
Personal and Business Announcements	230
Launches and Trial Trips	230

THE ENGINEER.

AUGUST 26, 1921.

The Airship Disaster.

The disaster which overtook the airship R 38 at Hull on Wednesday evening almost on the eve of her being handed over to the American Navy Department, for her flight across the Atlantic, strikes a bitter blow at aeronautics in general and at the airship section of it in particular. It has occurred at a peculiarly inappropriate time, for it would be unreasonable to expect that the disaster will not have an almost decisive effect upon the immediate future of airship construction and employment in this country. Schemes for instituting regular airship services between these islands and the Dominions by means of the airships left to us as a legacy of the war were under serious consideration, and it certainly appeared that some fair chance existed of their being put into practice. It is true that the R 38, having been acquired by the United States, was not included within the scope of any of these schemes, but it cannot be doubted that when she fell into the Humber she wrecked more than herself. She represented the latest British practice in airship construction, if not the latest ideas in the way of design, and by the results obtained from her operation any farther airship building in the country to meet the needs of the Imperial airship services would have been guided and influenced. She has gone before anything other than her first flight trials had been carried out, and although an all but completed ship of substantially similar design is left behind, it is hardly to be expected that her destruction will leave unaffected the future programme, either of construction or employment of airships.

Were we thoroughly convinced that airships are practicable means of commercial transport, that the inter-Imperial airship services which have recently been prominently discussed were of really vital importance to our Empire, we would urge the view that Wednesday's disaster should be put to good use by a careful analysis of all the available information bearing upon its cause. We are, however, far from being so convinced, and therefore feel that to enter into details, particularly at this stage, when little official information on the disaster is available, is somewhat futile, except for the sake of drawing a general inference from the event. An inquiry will no doubt be held by the Air Ministry, but if precedent be followed, the results arrived at will not be published. In this case, however, apart from the fact that another nation is involved in the disaster—a fact which will probably compel publication—we would earnestly urge that whatever information can be definitely established should be made generally available. There are those who hold that the disaster should not be allowed to stop our airship plans, but that the lesson which it teaches—whatever that lesson may be—should be used to good advantage in future designs. We ought, we believe, to look at the matter in another light. We should view it as the touchstone that is to settle whether airships as a whole are to be relegated to the scrap heap and numbered among man's follies, or whether there is any reasonable prospect of their ever becoming practical and safe vehicles of transport. It is hard indeed to persuade ourselves, after this disaster, to agree to giving this class of vessel another chance, for the airship record, both during the war and since the Armistice, has been full of unfortunate occurrences of more than isolated significance. Still, if it could be established that the R 38 met with disaster as a result of some peculiar condition or circumstance which would be unlikely to arise again or which once realised could be definitely avoided, we should be inclined to favour the view that airships as a whole should not be completely abandoned. We cannot, however, in this matter forget that this airship was claimed to embody all the experience of British and German practice accumulated up to the date of the Armistice. She was designed under the most favourable circumstances possible. She was not a war-time production, for her construction was not begun until just a few days before hostilities ceased. We must judge her accordingly. It may be said, by way of excuse, that she was the first vessel of a new type, and that accordingly she deserves leniency in our judgment of her shortcomings. In her details we are willing to accord her consideration in this respect, but nothing which could cause a disaster of the nature which has overtaken this ship can be classed as a detail. Rightly or wrongly—and we think rightly—the public will regard the disaster as finally determining whether or not airships as a whole are practicable and reasonable, and will refuse to concentrate on the particular issues of the accident as bearing on the particular design of the vessel to which it has happened.

We do not wish at present to discuss the matter further, for there is little definite information so far available to guide us. We recall, however, that as a result of a personal examination of the vessel before she left her shed at Cardington, we felt some doubts as to the soundness and strength of the manner in which the engine cars were attached to the main frame and in which the propeller thrusts were transmitted thereto. In our description of the vessel which we published after our visit we hinted at our fears, and suggested that the weakness anticipated would be especially noticed when the vessel was inclined in the vertical plane as when rising or falling. It is to be recorded that during her first trials an unspecified weakness in the frame structure is officially stated to have become manifested, and that modifications had been introduced to cure it. At the time of the disaster the vessel was apparently conducting full-speed trials and testing her rudders. The conditions were therefore most favourable for any inherent structural weakness to become manifest. On this point we shall doubtlessly be informed in due course, for among the few survivors of the crew on board is the Commander, Flight-Lieutenant Wann. He indeed is already reported to have said that the probable cause of the disaster was the snapping of some of the framework girders when the ship was made to turn sharply at a high speed, a view held, too, by Mr. Bateman, of the National Physical Laboratory, who is also among the survivors. In this connection it should be noted that to meet the exigencies of head room in her shed, the vessel was constructed with the engine cars arranged on the port and starboard sides, and not on the centre line as is usual. However it be, whatever the cause of the disaster may be traced to, we urge that the inquiry should not be allowed to stop at its elucidation, but that it should be extended to a more general survey of the whole field of airship design and construction as now seen after many years of work and many accidents and disasters. Are the unknowns in airship design unreasonably numerous? Is there any prospect of their being reduced? Can we anticipate a time when airship construction shall have progressed so far that accidents will be as rare in the air as on sea, or are the conditions wholly against us? To these questions answers must be given if the public is to regard with anything approaching equanimity farther efforts to improve the airship.

Battery Vehicles.

No section of the electrical industry has been more prosperous within the last few years or is in a better condition at the present time than that which is devoted to the production of battery vehicles. Although in these days the initial cost is anything but low, and charging facilities are none too adequate, there is a demand in certain quarters for electric vans and lorries for the delivery of business firms' goods within restricted areas. Many municipal bodies throughout the country are, of course, also

employing battery road vehicles on a more or less extensive scale, for collecting dust and so forth; whilst in factories, warehouses, and on railway platforms, and at docks, electric trucks are displacing those operated manually. The fact that several old-established engineering firms, with reputations to maintain, have embarked upon the manufacture of electric vans and lorries, indicates pretty clearly that the old troubles have been overcome. But, of course, the system has its limitations. For long runs and high speed travelling, petrol easily holds its own, and will, in all probability, always continue to do so. Electric battery road traction is applicable mainly to town work, involving total daily runs of 40 or 50 miles, moderate speeds, and fairly frequent stops. For such service electric propulsion is economical and often desirable in other ways. The simple manner in which a battery vehicle can be controlled, the smooth running, cleanliness and quietness, and the small number of moving parts, constitute advantages which often go a long way towards inducing business firms to adopt electric transport.

No doubt in time to come, and when prices have dropped to a lower level, the number of electric delivery vans will greatly increase, but progress will unquestionably be governed to some extent by the facilities which are provided for charging. Large business firms can afford to install motor generators and charging switchboards of their own, but the user of a single light van or runabout often prefers, on account of cost, to obtain his current at the nearest generating station or at some other charging centre. If current could easily be secured at the correct charging voltage in all cities and towns the electric vehicle industry would, no doubt, reap great benefit. All things considered, however, progress within the last few years has been satisfactory. Of the various classes of electric vehicles that have been introduced, the electric truck holds at present the most important position. During the war its value in the direction of saving labour and speeding up operations was demonstrated more clearly than ever before, and there is no doubt that the great increase in the demand for these little vehicles is attributable in no small measure to the experience gained with them during that strenuous period. Several of the railway companies which adopted one or two of these trucks soon after they were introduced into this country have since put others into service, and there has also been very substantial progress at docks. The electric truck business in this country has grown more rapidly than is generally supposed, but there are still many potential users. Battery locomotives have also made good headway at collieries, in railway shunting yards, &c. Years ago railway engineers would not, we fancy, have entertained the idea of utilising battery engines at all. Now, however, their possibilities on railways are freely discussed without any apparent fear of trouble. In his recent paper read before the Engineering Conference of the Institution of Civil Engineers, Mr. James Dalziel referred to the usefulness of these engines in railway yards in which the work is moderate and fairly uniform, and especially in cases in which fairly long lengths of infrequently worked sidings are involved, for in such cases battery locomotives will economically replace horses or capstans in connection with shunting. It was also shown by the author, and by Sir Henry Fowler in the course of the discussion, that the system might be adopted with marked advantage on small branch lines, quite apart from the question of ordinary electrification. There are in this country a great many branch lines, three or four miles long, on which trains run only two or three times a day, and on which it would be inadvisable, from a financial standpoint, to use either an overhead wire or a third rail. It is now abundantly evident that, like the electric truck, the battery locomotive will be utilised very extensively in the future. On the Midland Railway a battery engine, which is described in Mr. Dalziel's paper, has replaced five horses and five men originally engaged in shunting operations, and it seems that an engine built at the present time would save, under similar conditions, no less than £800 per annum.

The facts that are constantly being brought to light by responsible engineers who have tested modern battery engines should remove any doubts that may exist as to their suitability for commercial operations, but it should be clearly understood that the battery system has its limitations. Where arduous conditions are imposed by steep gradients or heavily worked sidings, the trolley engine is undoubtedly far more suitable than is the battery vehicle, on account of its ability to deal with large overloads. Under the right conditions all battery-worked vehicles can, if properly built, be relied upon to render good service, but if they are called upon to perform work for which they are not intended, the results will naturally be far from satisfactory.

Elongation and Gauge Length in Tensile Tests.

By J. H. G. MONYPENNY.

The fact that the percentage elongation obtained in a tensile test on any given steel depends on the relative values of the length and cross sectional area of the test piece has long been known. It has been provided for in British standard specifications and also in similar standard specifications issued in other countries by the use of standard forms of test pieces. In most specifications, in order to meet the requirements of varying sizes and shapes of the articles tested, more than one size of standard test piece is given and, in most cases, the relationship between length and area is fixed by an equation of the form $L = K_1 \sqrt{A}$ or $L = K_2 . D$, where L, A and D are the length, cross sectional area and diameter of the test piece and K_1 and K_2 some constants. Unfortunately, however, the values of these constants vary very greatly in the standard forms adopted by the several countries. This variation is shown in the following table, which gives the figures for standard cylindrical forms of test pieces in the countries named.

	L. in.	D in.	A. sq. in.	$L \sqrt{A}$.	L/D.
British test pieces:					
C ..	2 ..	.564 ..	.25 ..	4.0 ..	3.55
D ..	3 ..	.798 ..	.5 ..	4.25 ..	3.76
E ..	3½ ..	.977 ..	.75 ..	4.04 ..	3.58
France, Russia, Belgium:	mm.	mm.	sq. mm.		
	72 ..	10 ..	78.5		
	100 ..	13.8 ..	149.5	.. 8.16 ..	7.2
	115 ..	15.96 ..	200		
Germany, Austria:					
	100 ..	10 ..	78.5		
	200 ..	20 ..	314	.. 11.3 ..	10.0
	250 ..	25 ..	491		
U.S.A.:	in.	in.	sq. in.		
	2 ..	.505 ..	.2 ..	4.48 ..	3.96

With the very great variations shown above it is to be expected that the values for elongation will vary widely when using the various standard test pieces specified in the different countries.

The total elongation obtained from any test piece is made up of two distinct parts:—(*a*) The approximately uniform elongation over the whole length of the test piece; and (*b*) the local elongation due to the "neck," this part being independent of the length of the test piece.

The relative proportions of these two parts vary with different steels and, in the same steel, with varying heat treatment. This fact is illustrated by the curves in Fig. 1, which show the elongation per cent. on varying gauge lengths in different test pieces. In all cases the test pieces were 8in. long and .564in. diameter, and were marked off in inches previous to testing. The elongation values on the shorter gauge lengths were measured in such a way that the fracture was situated in the centre of the actual length of test piece measured. Test pieces A and B were respectively a nickel steel in the normalised condition and a nickel-chrome steel after hardening and tempering. Curves C and D were obtained from a 50–55-ton carbon steel after varying treatment, sample C being normalised and sample D hardened and tempered. The tensile results obtained were as follows:—

	Y.P.	M.S.	E. per cent. on 2in.	R.A. per cent.
A	25.4 ..	40.75 ..	33.0 ..	54.6
B	51.2 ..	59.25 ..	27.0 ..	62.6
C	28.9 ..	51.2 ..	24.7 ..	33.5
D	37.4 ..	53.1 ..	27.2 ..	57.0

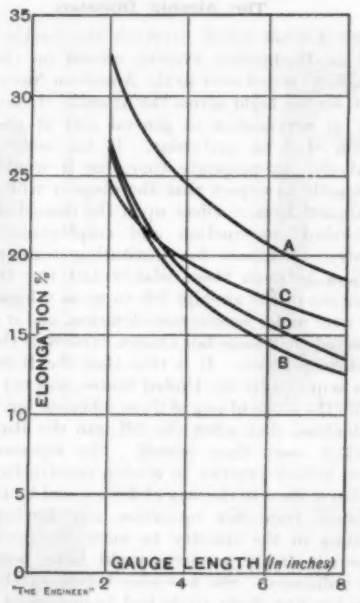


FIG. 1

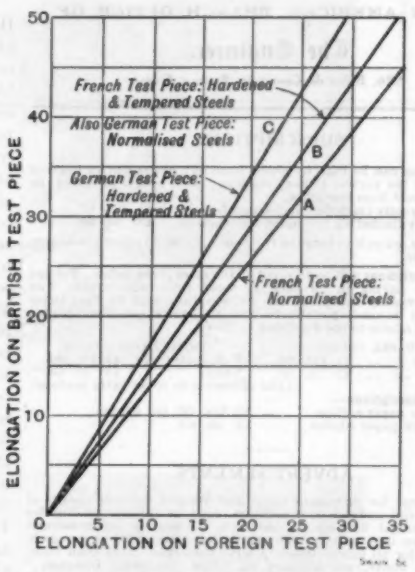

French Test Piece: Hardened & Tempered Steels
Also German Test Piece: Normalised Steels
German Test Piece: Hardened & Tempered Steels
French Test Piece: Normalised Steels
ELONGATION ON BRITISH TEST PIECE
ELONGATION ON FOREIGN TEST PIECE
A
B
C

FIG. 2

It is obvious, therefore, that the relation between the elongation values on, say, the British and French test pieces will vary or not with different steels according to whether the ratio between the separate parts (*a*) and (*b*) of the total elongation, given above, varies or not in the several test pieces from these steels.

The writer recently carried out a series of comparative tests, in the manner indicated in the last paragraph, on a large series of steels to see if it were possible to fix some approximate relationship for commercial use between the values obtained on the British standard test piece on the one hand and the French and German types on the other. The range of steels investigated included carbon steels ranging from a very mild type suitable for case-hardening purposes up to .60 to .70 per cent. carbon steel, as used for tires, and the various types of alloy steels used in the automobile and aircraft industries. All the samples used were in the form of rolled bars of moderately small sizes, i.e., 1in. to 2in. in diameter. The steels were tested in the hardened and tempered condition—up to about 65 to 70 tons maximum stress—and, in addition, the carbon steels and such of the alloy steels as do not air harden were tested after normalising. The milder carbon steels were also tested in the rolled condition without any further treatment. Test pieces of a cylindrical form only were used.

As might be expected from the results shown in Fig. 1, it was found that the steels could be grouped into two classes: (*a*) carbon steels and non-air-hardening alloy steels when in the normalised—or rolled—condition; (*b*) carbon and alloy steels in the hardened and tempered condition. In each of the two groups the values of the ratio between the elongation on English and French or English and German test pieces were approximately constant, but these ratios varied considerably between the two classes. The results obtained are plotted in Fig. 2, from which one may obtain the approximate equivalent elongation per cent. on a French or German test piece corresponding to a given value on a British standard test piece or *vice versâ*. It will be noticed that, by a coincidence, the ratio between British and French test pieces for hardened and tempered steels is the same as that between British and German for normalised steels.

For rough calculations the approximate figures given in the following table may be useful. The elongation on the British test piece should be multiplied by the given fraction to obtain the equivalent values on the foreign piece. The values of the ratios used in plotting Fig. 2 are given in brackets.

	Elongation per cent. on French test piece.	Elongation per cent. on German test piece.
Normalised or rolled steels	¾ (.77)	¾ (.69)
Hardened and tempered steels	¾ (.69)	⅔ (.59)

It will be understood that the values given are only approximate. For example, in nickel-chrome steels containing about 3 per cent. nickel and 1 per cent. chromium, when hardened and fully tempered, the local elongation due to the neck is confined to a shorter length of the test piece than with carbon steels or even nickel steels treated in a similar manner. With such nickel-chrome steels, therefore, the ratio of elongation on the British piece to that, say, on the French piece, tends to be somewhat higher than with the other steels. The difference, however, is not great.

In the case of some of the iron alloys which give a high figure for elongation per cent., the test pieces stretching to a great extent over their full length, it would be expected that the values given in the above table and in Fig. 2 would not apply. As an illustration

the following figures were obtained from an iron-nickel alloy containing 46 per cent. nickel. In the form of a bar 1¼in. diameter this material gave the following results in the rolled condition and after softening by water quenching from 900 deg. Cent.:—

	Y.P.	M.S.	R.A.	Elongation per cent. B.S. test piece.	Elongation per cent. French test piece.	Elongation per cent. German test piece.
			p.c.	p.c.	p.c.	p.c.
As rolled	22.0	37.9	61.5	40	32	29.2
Water quenched from 900 deg.	16.9	34.3	68.8	50.5	40.5	38

These figures give mean values of the ratios French-English and German-English of .80 and .74 respectively. These values are somewhat greater than those given above for normalised steels, but the difference is probably less than one would expect.

It may be of interest to mention that the average general elongation per inch of test piece—.564in. diameter—on these two test pieces—that is, the elongation apart from the local elongation due to the neck—was .23in. for the rolled bar and .31in. for the water-quenched bar. For comparison a sample of very mild steel tested in the same way and giving 45 per cent. elongation in 2in. had a general elongation of .22in. per inch. The local extension due to the neck was spread over a longer length of the test piece in the mild steel than in the nickel-iron alloy.

Some measurements were also obtained confirming in a general way Barba's law of the equivalence of geometrically similar samples. Duplicate test bars were prepared from a number of steels after varying treatments and one of each was turned to a test piece 15 mm. diameter and the other 20 mm. diameter. All the test pieces were 230 mm. long and the elongation was measured on 75 mm., 100 mm., 150 mm., and 200 mm., thus giving two series of geometrically similar test pieces. The results were as shown below :—

	Elongation on test piece. 75 by 15 mm.	100 by 20 mm.	Ratio 75/100.	Elongation on test piece. 150 by 15 mm.	200 by 20 mm.	Ratio 150/200.
1. Very mild steel normalised	39.3	35.7	1.10	31.2	26.8	1.17
2. Nickel steel normalised	30.7	28.6	1.11	23.7	21.7	1.09
3. Nickel steel hardened and tempered ..	22.0	22.5	.98	15.3	14.9	1.03
4. Tire steel normalised	21.3	21.5	1.01	16.7	16.0	1.04
5. Tire steel hardened and tempered	22.0	20.1	1.09	15.2	13.7	1.11
6. 3 per cent. nickel steel hardened and tempered	24.0	22.9	1.05	18.0	16.6	1.08
7. 3 per cent. nickel, 1 per cent. chrome steel hardened and tempered	21.2	18.5	1.14	13.9	12.0	1.06
		Mean ..	1.07		Mean ..	1.08

It will be seen that test pieces geometrically similar give very similar results for elongation, though in almost every case the smaller test piece gives a somewhat higher figure.

The other values, apart from elongation, obtained from these test pieces were :—

Test No.	15 mm. piece. Y.P.	M.S.	R.A.	20 mm. piece. Y.P.	M.S.	R.A.
			Per cent.			Per cent.
1	18.5	28.3	66.0	18.8	28.9	62.9
2	24.4	40.8	54.1	26.2	41.4	53.1
3	39.8	48.8	64.9	42.4	49.5	62.9
4	27.9	50.4	39.5	29.6	51.4	39.0
5	37.3	53.8	55.3	38.0	53.0	52.6
6	37.6	49.7	62.9	39.4	49.7	62.9
7	53.2	60.3	61.8	52.9	60.6	60.5

These figures show that the duplicate test pieces had practically identical properties.

As mentioned earlier, the results quoted were obtained on bars of comparatively small section. This condition was imposed mainly because the results were intended to be used in connection with the automobile and aircraft industries in which such small sizes are generally used. The results will, however, apply to test pieces obtained from larger sections providing such test pieces give ductility figures—*i.e.*, elongation and reduction of area—comparable with those obtained from the smaller samples. Frequently, however, the larger-sized pieces, especially of plain carbon steels, do not give such high ductility figures mainly because the test piece does not neck to the same extent before breaking. In such cases the ratio between the elongation per cent. on different lengths will vary to a greater or less extent, depending upon the amount of necking actually taking place. The variation which may be obtained is illustrated by the following figures given by mild steel forgings 6in. and 10in. diameter, the samples being prepared in such a manner as to give varying ductility figures :—

Size.	M.S.	E.	R.A.	Ratio, French-English.	Ratio, German-English.
in.		p.c. 2in.	p.c.		
10	31.1	37.0	52.2	.78	.71
10	31.1	22.5	20.1	.87	.84
6	31.1	37.5	54.6	.79	.72
6	31.7	33.0	47.9	.79	.73
6	29.9	22.0	26.0	.86	.77
6	31.4	40.0	59.0	.77	.69
6	31.4	30.5	40.0	.77	.70

It will be seen that where the ductility figures approach those obtainable from the smaller-sized bars the ratios between the longer foreign pieces and the shorter British are similar to those given earlier ; when, however, the figures are not as good, then the values of the ratios increase to a considerable extent.

Obituary.

SIR SAMUEL C. DAVIDSON.

We have to record with much regret the death of Sir Samuel Davidson, K.B.E., chairman and managing director of the "Sirocco" Engineering Works, Belfast, which took place at Bangor, County Down, last week. Sir Samuel, who was well and widely known as an enterprising and successful inventor, was one of the oldest living representatives of the tea planting community. He was born in 1846 in County Down and he received his education at the Royal Academical Institution, Belfast, evincing even in those days a keen interest in science and engineering. On leaving school at the age of fifteen he entered the office of Mr. William Hastings, a Belfast civil engineer, where he remained till the summer of 1864, and where he acquired a good knowledge of surveying and a rudimentary training in architecture and railway engineering.

Sir Samuel Davidson's father about that time—1864—purchased a share in a tea estate in India, and, believing that his son would have better prospects of advancement in life as a tea grower—that industry being then in its infancy—sent him out to India in the autumn of the same year. The young man proceeded to the tea district of Cachar, which, though only about 300 miles north-east of Calcutta, took three weeks' travelling by river boat, whereas now, by steamer and railway, it only takes about two days. On his arrival he acted as assistant manager for two years and then became manager of the estate in which his father was interested. After his father's death in 1869 he bought out his co-partner and became sole proprietor.

During his sojourn in the East Mr. Davidson, as he then was, soon realised the inadequacy of the primitive methods then employed for tea manufacture, and practical experience, combined with his inventive genius, suggested to him the possibility of using mechanical apparatus for drying the tea leaf at the plantations. The result of his investigations of the subject promised so well that he subsequently gave up tea planting and returned to Ireland, where he founded the "Sirocco" Engineering Works. From those works he introduced to a sceptical community the first tea-drying machines. Scepticism, however, soon gave place to practical appreciation of his invention when the manufactured product was found to obtain a higher price in the market. Such an achievement may be considered as all the more remarkable, seeing that he never had any previous mechanical or chemical training beyond what he had acquired in his school-days.

Subsequently Sir Samuel took out a very large number of patents at home and abroad, and, in addition to the machinery which he designed for every process in the manufacture of tea, his inventions include the "Sirocco" fan, which is very widely employed and by which he claimed to have revolutionised factory and mining conditions and life afloat. In this connection it is interesting to note that some of the greatest engineering experts of the period assured Sir Samuel that his fan could not possibly work, as its construction was opposed to all the recognised scientific laws pertaining to the mechanical propulsion of fluids ; but in spite of their prophecy the "Sirocco" fan has become one of the outstanding triumphs of his inventive genius. During the time he was perfecting it and afterwards he carried out a vast series of tests and investigations on scientific lines, and it is probable that he knew more about the action of fans than any other living man.

Mr. Davidson started the "Sirocco" Engineering Works in 1881 with one small workshop and seven workmen. The works now employ about 1000 hands, and there are also branches and representatives of the business in all parts of the world. Many of the branches were actually founded by himself personally.

Sir Samuel's latest achievement was the invention of a new process for the manufacture of raw rubber and of specially designed machines for the purpose. This process was shown for the first time at the recent Rubber Exhibition in London and excited considerable interest among rubber planters and manufacturers, who were most favourably impressed with it.

While the tea machines, fans, and rubber process are certainly three of Sir Samuel's most famous inventions and have involved the taking out of hundreds of individual patents, his inventive capacity was by no means confined to them alone. His patent records give evidence of a remarkable versatility and show that during his career he has found time to devote his attention to the invention of such things as special tennis poles, belt rivets, and steam engines, and the production of non-alcoholic beverages from tea, coffee and cocoa. The manufacture of peat into briquette form was still receiving his attention at the time of his death. In his early days he was a keen sportsman, and his trophies at home and in his office proved that he was a good shot while he was out East. In later life he has found relaxation in the cultivation of his beautiful gardens at his home, Seacourt, Bangor, Co. Down, carrying out even here many a scientific experiment in horticulture and arboriculture.

During the war, in which, be it said, he lost his only son, Sir Samuel devoted his energies wholeheartedly to the service of his country and carried out much useful work. There is but little doubt that the drain put upon his energies on that account and by the large part he had taken during recent years in the affairs of State hastened his end.

SIR SAMUEL C. DAVIDSON

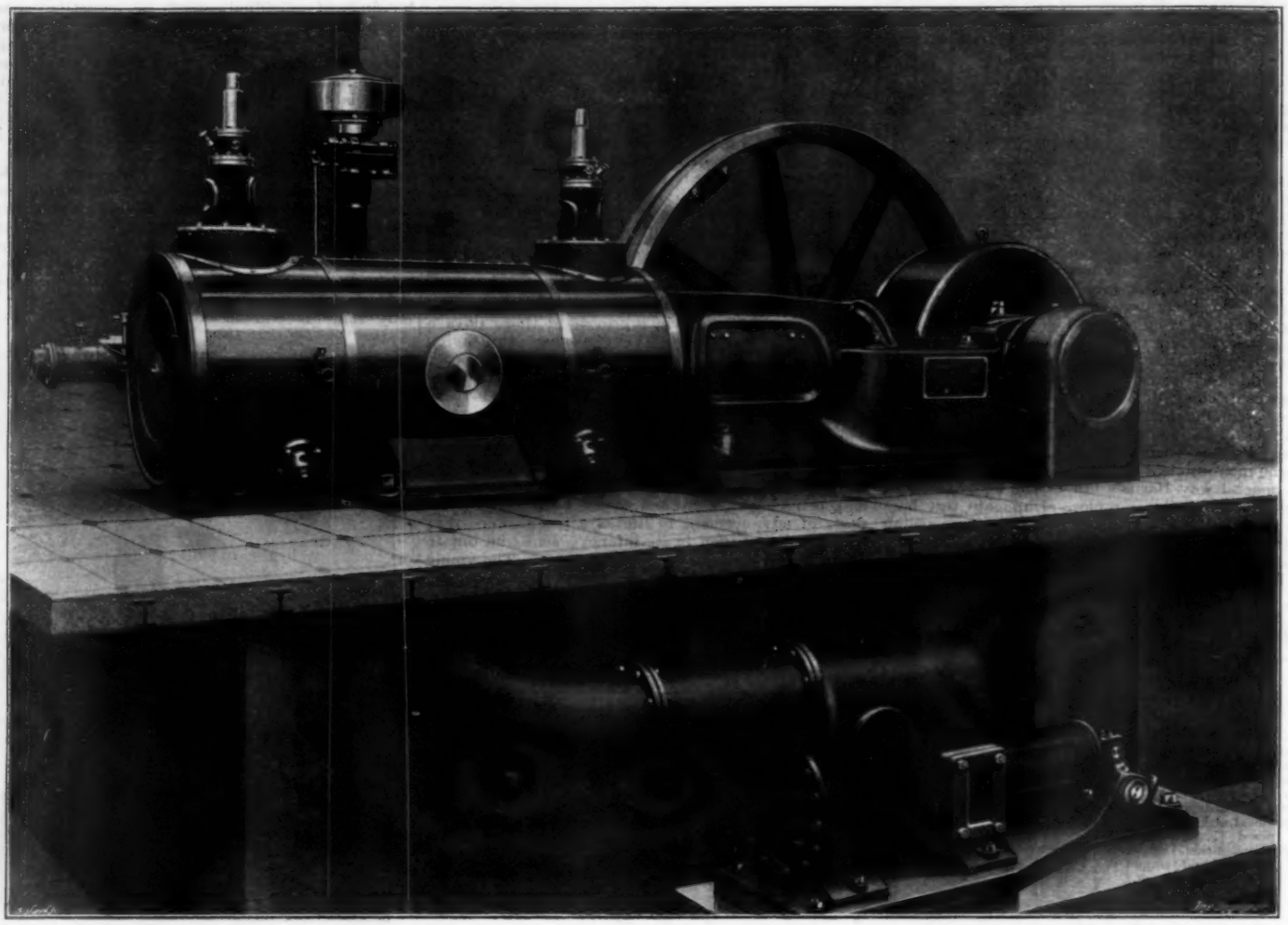
Sir Samuel had been a member of the Institution of Mechanical Engineers since 1888. Quite recently he was created Knight of the Order of the British Empire, and was unfortunately too unwell to have the honour conferred on him by the King personally during His Majesty's recent visit to Belfast.

ROBERT SOMERVILLE.

The death took place on 22nd inst., at Dalkeith, of Mr. Robert Somerville, the chairman of George Gibson and Co., Limited, shipowners, Leith, who was one of the oldest of Scottish shipowners. Mr. Somerville, who was in his ninety-third year, was born at Dalkeith in 1829. At the age of fourteen he entered the office of a Leith shipbroker and general merchant, and at the conclusion of his apprenticeship he was engaged by Messrs. George Gibson and Co., shipowners, in which firm he eventually became a partner. When he first entered the business the firm had several small sailing vessels running to Hamburg and Rotterdam, and one dock was sufficient to accommodate the shipping which visited the port of Leith. Soon afterwards, when the application of the steam engine to marine navigation was engrossing attention, Mr. Somerville recognised the tendency of the times, and in 1850 he placed the first order for his firm for a steamship. The later developments in marine engineering were fully taken advantage of, and by the time he had attained the management of the concern, a fleet of over a dozen steamers was regularly sailing. In the development of merchant shipping enterprise in Scotland, Mr. Somerville established important branches of the firm at Glasgow and Dundee, and business working arrangements at Hull and Middlesbrough. He assisted in all the important changes which marked the progress and development of the port of Leith, and early in his career was chosen a member of the Leith Dock Commission. In many ways he devoted himself to advance the trade and general welfare of the town.

200 HORSE-POWER UNIFLOW STEAM ENGINE

GALLOWAYS, LIMITED, MANCHESTER, ENGINEERS



200 H.P. Uniflow Steam Engine.

THOSE of our readers who followed the correspondence in the pages of THE ENGINEER on the subject of the uniflow engine subsequent to the paper read by Mr. F. B. Perry at the Lincoln meeting of the Institution of Mechanical Engineers last year will be interested in the design of an engine of this type which has recently been constructed by Galloways, Limited, Manchester. The most novel features in this engine are a shockless high-speed valve gear and a compression release device designed by Mr. Henry Pilling, the general manager of the firm. In other respects the general features of the engine follow orthodox uniflow principles; that is to say, the steam is admitted at the ends of the cylinders and is exhausted through a ring of ports midway in the cylinder walls, the ports being uncovered by the piston when it reaches about 90 per cent. of the working stroke and covered again at about 10 per cent. of the return or compression stroke. The advantages claimed for this arrangement are, of course, well known to mechanical engineers. The steam ports and cylinder walls adjacent to them are not subjected to the cooling action of exhaust steam rushing past them, while the exhaust ports are not exposed to live steam. In this manner cyclical fluctuations of temperature in the cylinder walls are greatly reduced; the temperature from the inlet to the exhaust portions falls gradually and surface condensation is prevented.

In the uniflow engine, as the whole of the expansion of the steam occurs in one cylinder, the cut-off takes place exceptionally early, actually at about 7½ to 10 per cent. at full load. The steam valve has, therefore, to be opened and closed again while the crank travels through from 25 deg. to 35 deg., or in one-fortieth to one-thirtieth of a second when the engine is making 160 revolutions per minute. The new hydraulic valve gear which Mr. Pilling has invented performs the opening and closing operations quietly and efficiently, joints and pins and other moving parts which are liable to wear being conspicuous by their absence.

Another characteristic feature of the uniflow engine is the high compression in the cylinder, which is brought about by the early covering of the exhaust ports. The clearance volume is such as to limit the compression to a pre-determined maximum when the engine is operating on a normal vacuum. The clearance volume is usually from 2 to 3 per cent. of the piston's displacement. With the clearance space fixed, therefore, it is obvious that a poor vacuum will cause an increase of compression in the cylinder, which might become excessive and dangerous if suitable preventive mechanism is not provided. In the engine under notice an automatic compression release device of original design is provided.

The engraving above represents a general view of the engine. Fig. 1 is a sectional elevation, Fig. 2 gives a section of the cylinder and of the hydraulic valve gear, Fig. 3 shows the arrangement of the automatic exhaust gear, and Fig. 4 shows a set of indicator diagrams which speak for themselves. The engine is one of three intended for driving centrifugal pumps employed for drainage purposes in South America. The rated full load is 200 brake horse-power, the diameter of the cylinder 20in., stroke 24in., steam pressure at the stop valve 160 lb. per square inch, and the superheat 120 deg. Fah. The vacuum is obtained by a jet condenser and air pump driven from the engine crank shaft. The bed frame is a single casting supporting the two main bearings and the bored crosshead guide. In this frame the metal is disposed well along the lines of stress, the side walls being high. The bed frame is rigidly bolted to the foundation and the connection between the cylinder and the frame is by a circular spigoted joint.

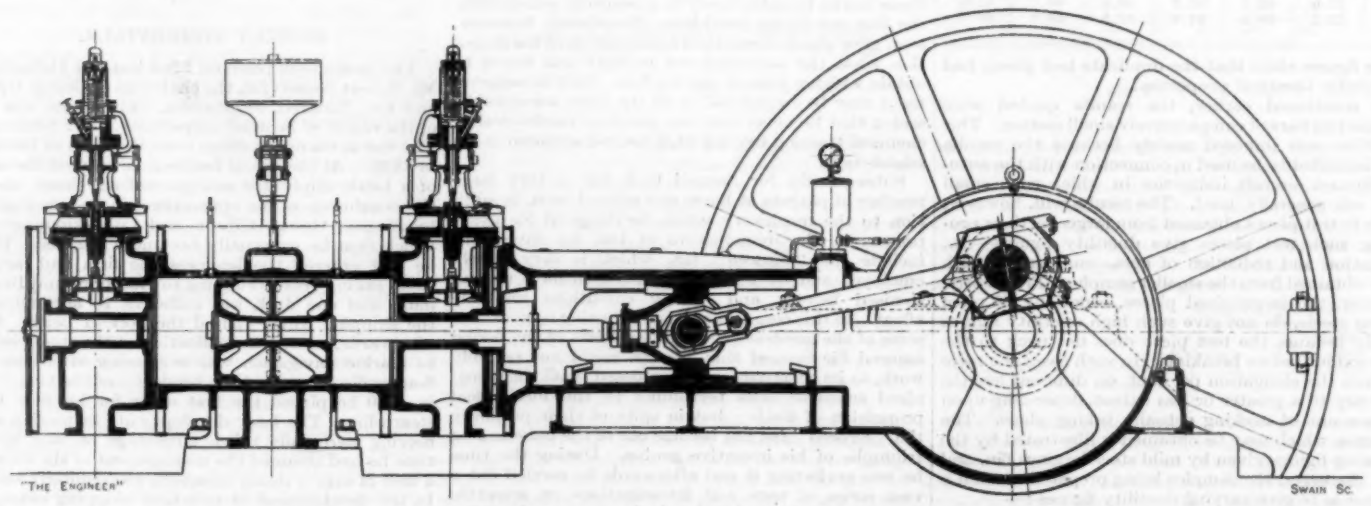


FIG. 1—SECTIONAL ELEVATION OF 200-H.P. UNIFLOW ENGINE

Being of comparatively small size, the cylinder in this case is not of the patented built-up form of construction which has been adopted by Galloways for large cylinders. The cylinder casting has an inspection door so that the inner surface of the cylinder, as well as the piston rings, can be inspected without removing the cylinder covers or piston. In boring the cylinders and turning the piston allowances are, of course, made for the temperature differences which will occur in working, so that the clearance at all points of the stroke will be as uniform as possible. Each cylinder cover also acts as a valve chest and the steam ports are thus as short and direct as possible. The covers are steam jacketed, and in order to prevent the conduction of heat from the front cover to the bed frame the contact between these parts is restricted to pads or projections registering in the bed frame.

The piston—Fig. 1—is made in two parts, each with deep bosses fitting on the piston-rod. The two parts are spigoted near the outer cylindrical surface and held firmly together by conical faced nuts on the piston-rod. It will be seen from the sectional elevation that the steam valves are double seated. They are made of cast iron and of comparatively shallow depth, to give steam tightness under high temperatures. The new valve gear, Fig. 2, by which the steam valves are operated is a simple piece of mechanism. In this gear oil under pressure is applied below the plunger A connected to the valve spindle B and lifts the valve, which seats itself again by the action of a spring and dashpot C when the fluid pressure is released. An excentric on the lay shaft operates the ram D of an oil pump arranged in the valve bonnet. The pump ram is hollow and has a ring of slots or ports E, which at certain parts of the travel may be covered by a sleeve F surrounding the pump ram, the axial position of this sleeve being controlled by the governor. On the up-stroke of the pump oil is forced into the pressure chamber below the plunger, thus raising the plunger and the steam valve. At a point determined by the position of the governor the ports in the hollow pump ram overrun the sleeve and the oil escapes through the ports back into an oil reservoir. The steam valve is now free to close under the combined action of the spring and the dashpot piston, the seating of the valve being both rapidly and quietly performed.

We have had the opportunity of seeing the valve gear in operation with the engine running at 160 revolutions per minute. It was remarkably effective, giving a perfect control of the cut-off at any point from zero to about 60 per cent. of the stroke, and it operates with absolute silence. The prominent features of the valve gear are its compactness and the small amount of power required to operate it. The indicator diagrams serve to show how delicately the gear acts. They were taken by varying the position of the governor sleeve by hand while the pencil was kept continuously on the paper.

The other feature of special interest is the automatic compression release gear shown in Fig. 3. From the drawing it will be seen that two supplementary exhaust valves G H of the mushroom type are arranged on the side of the cylinder. These valves open inwards and are kept normally closed by the springs J K which act in conjunction with the pressure of the steam. On the engine lay shaft is a sleeve L carrying two cams M N of tapering form, which are capable of longitudinal movement on the shaft. The axial position of the cams is made to correspond automatically with the vacuum in the condenser by a spring-controlled piston O, of a small cylinder P, mounted at the end of the lay shaft. One end of the cylinder is open to the atmosphere and the other to the condenser. The piston operates the cams by means of the rod R. Under normal conditions of vacuum the small end of each cam is just clear of the roller on the supplementary exhaust valve stem and the valve remains seated; but if the pressure in the condenser rises, the piston in the vacuum cylinder moves out and by means of the rod R the cams move axially, so that they allow the exhaust valve to open during a portion of the compression stroke, as shown in the drawing, Fig. 3. The amount and duration of the valve opening depend exactly on the axial position of the cams and thus increase as the back pressure rises. It should be noted that under normal vacuum the valves, valve guides, and rollers are absolutely out of action. The gear has thus few moving parts and absorbs the minimum of power. As the engine operates its own air pump it has to start up without a vacuum, and this gear gives full relief of compression until a vacuum is established, then permitting the compression to increase until the full compression at normal vacuum is reached. This means that the engine need only be barred round to the starting position, after which starting is effected entirely by opening the steam stop valve. We had an opportunity of witnessing the operation of the compression release gear and can testify to its efficiency, both at starting and when the vacuum was purposely destroyed by admitting air through the "vacuum breaker" valve.

A short preliminary trial of the engine was carried out at Galloways' works before shipment. The engine was run at full load and speed, the power generated being measured by a Heenan and Froude dynamometer. As no surface condenser was fitted at the time the steam consumption was measured by observation of the boiler feed. The boiler being the same that was used for the heating system of the works with the heating pipes blanked off, neither the specified boiler pressure nor superheat was available. The piping arrangements were also temporary, the stop valve being about 20ft. from the cylinder. The pressure and superheat at the stop valve were 125 lb. per square inch and 50 deg. Fah. respectively, and in spite of these adverse conditions the results of the tests, after making the necessary allowances for the change

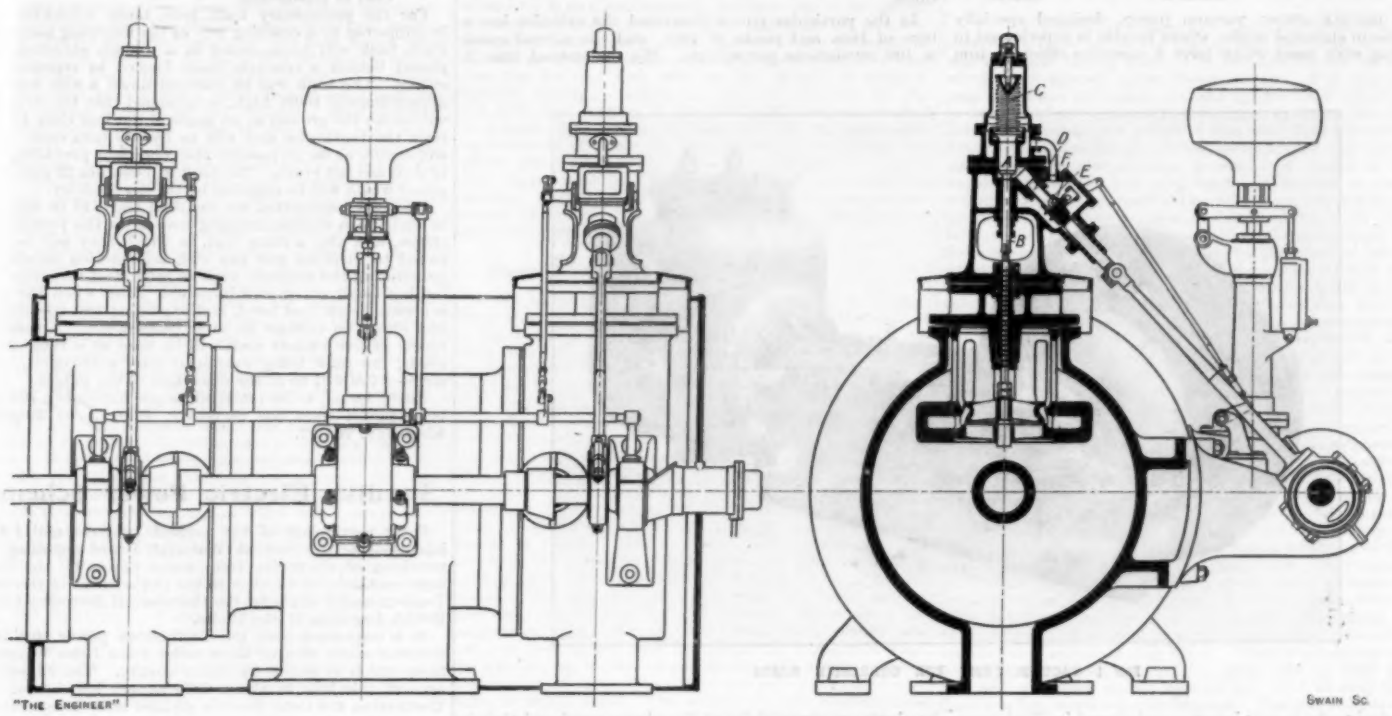


FIG. 2—SIDE ELEVATION AND CROSS SECTION OF CYLINDER

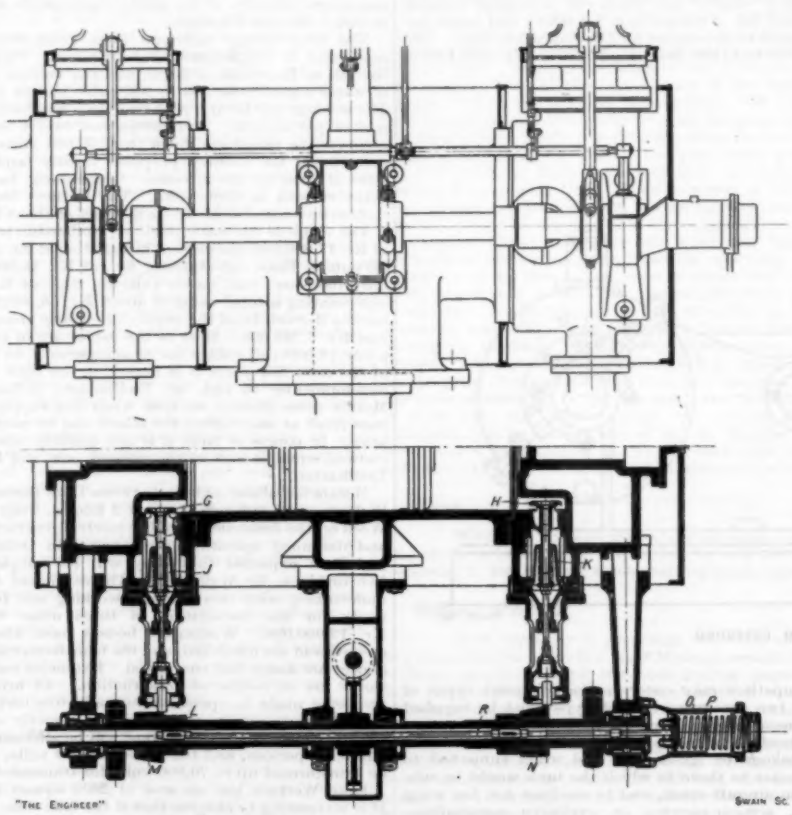


FIG. 3—ARRANGEMENT OF THE AUTOMATIC EXHAUST GEAR

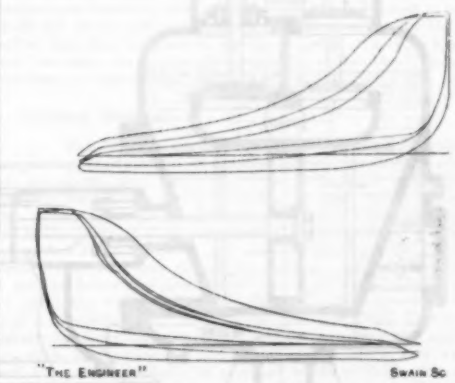


FIG. 4—INDICATOR DIAGRAMS

of pressure and superheat to the specified values of 160 lb. per square inch and 120 deg. Fah., confirm the figure guaranteed, namely, 12.6 lb. of steam per brake horse-power hour, which must be considered extremely satisfactory for an engine of such a comparatively small size.

Vacuum Pump for Corrosive Gases.

A DOUBLE-ACTING vacuum pump, designed specially for use in chemical works, where trouble is experienced in dealing with gases which have a corrosive effect on iron and steel parts, is now being manufactured by Tilghman's Patent Sand Blast Company, Limited, Broadheath, near Manchester. A general view of the pump is given in Fig. 1, while Fig. 2 is a part sectional elevation through the cylinder and valve chest. The special feature of the pump is the cylinder, which is so designed that the gas shall not come into contact with the working parts at any point of the stroke. This result is brought about by filling the cylinder with oil or some other fluid of a non-corrosive character to such an extent that when the oil is at its lowest level, *i.e.*, when the piston is at the end of its stroke, the cylinder wall, piston and rod all remain submerged. The cylinder is so designed that the cubical contents of the clearance space at each end is equal to the piston displacement, the gas in the space above the liquid passing through the delivery valve when the piston moves to the end of its stroke, while on the inlet side an equal quantity of gas passes through the inlet valve into the cylinder, but above the level of the liquid, which never falls below the moving parts of the pump. The corrosive gas can therefore never come into contact with any friction surfaces. The remaining portion, such as the valve chamber, is enamelled.

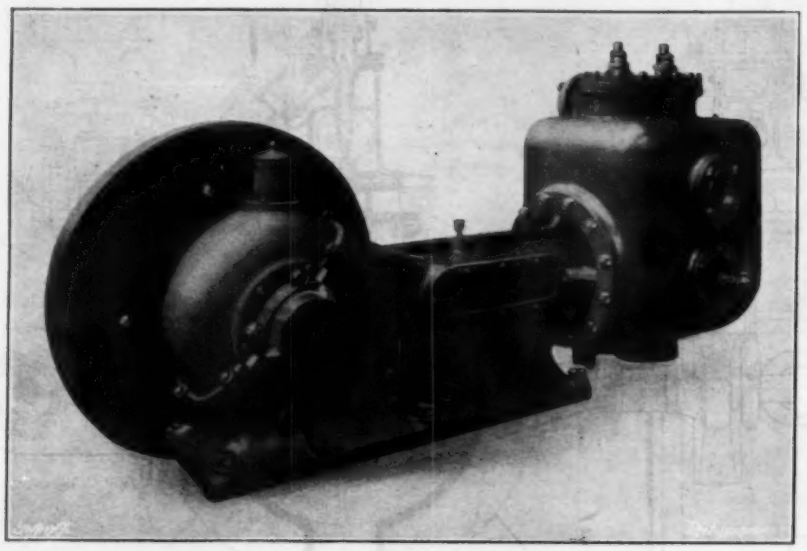


FIG 1—VACUUM PUMP FOR CORROSIVE GASES

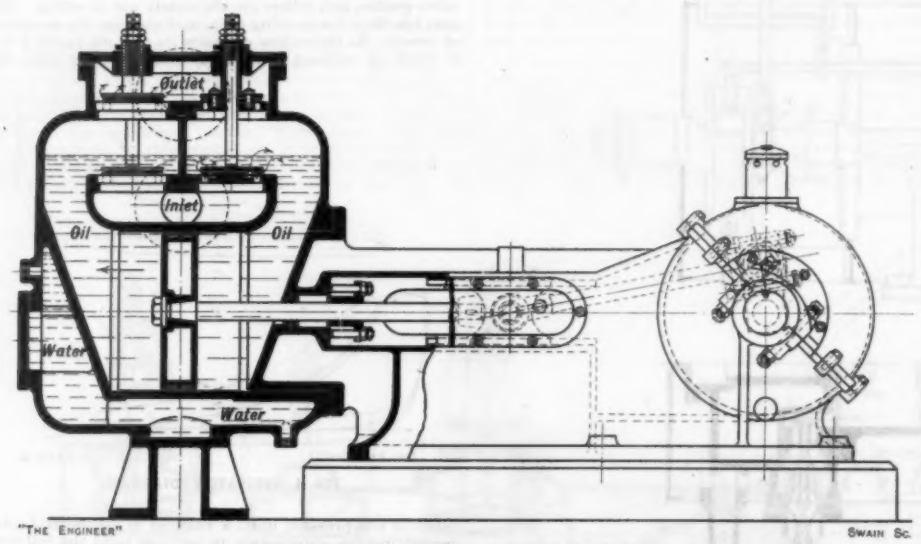


FIG. 2—SECTION OF PUMP THROUGH CYLINDER

It will be observed that the cylinder is water jacketed. The main parts, such as the bed, crosshead guides, crank shaft, connecting-rod, and valves are of the type usually adopted by this firm for its horizontal compressors and vacuum pumps. The moving parts are enclosed, dust-proof, and efficiently lubricated. The arrangement of the valves is clearly shown in the sectional drawing. Each valve consists of a number of thin metal plates or discs working on a removable seating. The two plates nearest the valve seat are made perfectly flat, the lowest plate being ground and the second one specially thick,and the other plates slightly buckled, so as to give the necessary spring, the lift of the valves being regulated by adjustable guard plates. The valves and seatings are made of brass or other metal which will resist the corrosive action of the particular gas which is being dealt with. Each valve and spring, together with its seating and guard, can be easily removed for inspection, the whole being held in position by the central screws. It is impossible to prevent a small quantity of the liquid in the cylinder passing through the delivery valves with the gas, but what does get through is trapped and returned to the cylinder on the inlet stroke at a point below the lowest level; thus a constant quantity of liquid is maintained in the cylinder at all times.

In the particular pump illustrated the cylinder has a bore of 16in. and stroke of 10in., and the normal speed is 100 revolutions per minute. We understand that it has been run successfully at the above speed and that it maintained a vacuum of 28in. to 29in. of mercury with the barometer standing at 30in.

Safety Tanks for Aircraft.

THE Air Ministry announces that, with the object of obtaining for use in service and commercial aircraft safety tanks which will not burst or leak, even though seriously damaged in a "crash," and which will withstand machine gun and shell fire, a competition for safety fuel tanks has been arranged to commence on December 1st, 1921. The first prize will be £1400, the second £400 and the third £200.

Any competitor may enter several different types of tanks, but two specimens of each type must be supplied for preliminary tests and four for the final tests.

Tanks should be constructed so as to prevent as far as possible leakage or ignition of fuel when subjected to stresses similar to those to which the tank would be subjected in an aircraft crash, and to machine gun fire using incendiary, armour-piercing or explosive ammunition. Equal importance is attached to these requirements. A tank is to be capable of being fitted within a space of 2ft. 6in. by 2ft. by 2ft., and to have a capacity which must be within 5 per cent. of 30 gallons, but any shape of tank will be accepted for competition. The maximum weight, which would only be justified by very exceptional qualities, should not exceed 1.75 lb., complete with fittings, per gallon capacity. Tanks exceeding this figure will not be disqualified, but great importance will be attached to low weight. In all cases the tank is to be complete with the necessary fittings to enable it to perform its functions of supplying fuel to a fixed point. The relative importance of other characteristics of the tanks will be considered in the following order:—

Light weight.
Durability under service conditions in the absence of any accident.
Indifference to extremes of temperature.
Adaptability of design to large capacities.
Simplicity of construction.
Adaptability of design to various shapes.
Accessibility of fittings.
Cost of production.

For the preliminary tests both tanks submitted will be subjected to a crashing test of the following nature:—Each tank will be mounted in a wooden structure and placed behind a concrete body formed to represent an engine. The tank will be released down a wire ropeway approximately 100ft. high, so arranged that the structure will strike the ground at an angle of not less than 45 deg. from the horizontal and will be free to turn over. This will ensure as far as possible the conditions prevailing in a typical aircraft crash. The tank will contain 22 gallons of petrol which will be supplied by the Air Ministry.

The tanks submitted for the final test will be required to undergo a similar crashing test as in the preliminary stages, and also a firing test, in which they will be subjected to machine gun fire with ammunition capable of penetrating the ordinary type of mild steel fuel tank and leaving small entry and large exit holes when the tank is struck below fuel level, and exploding and igniting the fuel either on contact or after penetration. A series of bursts of five rounds each will be fired at a range of 50 yards, the tank being examined after each burst. The angle of fire will be at the discretion of the judges.

Entry forms, to be returned before November 7th, can be obtained from the Secretary, R.D. 1, Air Ministry, Kingsway, W.C. 2.

Swedish Electric Power Scheme.

SOME particulars of the present progress and future intentions of the Swedish Waterfall Board regarding the provision of electricity from water power by the State were contained in a report to the Department of Overseas Trade recently made by the Commercial Secretary to the British Legation at Stockholm.

It is explained that the Trollhattan power station is situated about two or three miles from Lake Wennern, from which it draws its water supply. The superficial area of this lake is about 5570 square kilometres. At Trollhattan the Gota River is divided into three sections, one forming the traffic canal, the second being the canal which conveys the water for the power station, and the third being the original river proper which takes away the surplus water not required for the traffic canal or the power station. Lake Wennern can, however, be dammed at will, and it may be that, in course of time, if the large extensions in contemplation are carried out, the whole of the large volume of water draining from the lake will eventually be diverted for the production of electric energy. The present power station consists of eight turbines of 12,500 horse-power each and five of 13,200 horse-power each, making an aggregate of 166,000 horse-power at the turbine shafts. It is calculated that the maximum capacity of the electric generators may be put at about 105,000 kilowatts.

The total energy delivered from Trollhattan in 1920 amounted to 431,500,000 kilowatt-hours. The height of the fall at the works is 30 m. and the volume of the fall of water varies from 300 to 900 cubic metres per second. The average fall for the past two years has been 500 cubic metres per second. Trollhattan has twelve sub-stations equipped to transform down from 50,000 volts to 20,000 and 10,000 for country purposes mostly, and down to 6000 or 3000 for use in cities. Gothenburg, for example, takes current at 6000 volts. The farthest transforming station is situated at Skofdo, a distance of about 100 kiloms.

The value of the water itself at Trollhattan is estimated at Kr. 17,800,000, the present installation at Kr. 24,000,000, all outside lines, sub-stations, &c., at Kr. 16,000,000, and miscellaneous—viz., motor vehicles, &c.—at Kr. 700,000, representing a total value of about Kr. 58,500,000.* The income derived from the supply of electric energy in 1919 was Kr. 5,398,000. Most of the cables are of copper, but a few 10,000-volt cables are of aluminium. In the course of the next few years it is hoped, in the light of present developments, to link up Trollhattan, Alfkarleby and Motala more closely, so that when the supply of water runs short at one station the others can be used as auxiliaries. In course of time it is not unlikely that a second station, equal in size to the present one, will be built at Trollhattan.

Motala lies about midway between Lake Boren and Lake Wettern, or a distance of about 2 kiloms. from each lake. Work on the construction of the electric generating station and damming operations were begun in October, 1918, and it is expected that they will be completed—with two turbines—in April, 1922. The estimated cost of the undertaking with two turbines working and foundations ready for the installation of three other turbines is Kr. 12,000,000. Workmen's houses have already been erected and are inhabited, and the transformer and turbine houses are about half completed. Extensive embankment works are in course of construction. All arrangements are being made to operate eventually five turbines, each of 6000 horse-power, which will be directly coupled to electric generators. The current will be alternating, three-phase, 50 periods, and the pressure 6000 volts, which will be transformed up to 70,000 volts for transmission.

Lake Wettern has an area of 2000 square kilometres. It is interesting to observe that if the lake were absolutely enclosed for one month the water would rise about 3in. only. The present stream—the Motala River—which runs from Lake Wettern, is very irregular, and is considerably broken up in its descent to Lake Boren. Very extensive embankments are being constructed, and a lake will eventually be formed just above the electric power-house. The water will then be level with Lake Wettern, and there will be a fall of 15 m.—compared with 30 m. at Trollhattan and 50 m. at Porjus—of water to the turbines. The average volume of water available for one turbine will be 40 cubic metres a second.

* NOTE.—At par, 18.159 Swedish kroner equal £1 sterling.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

Successful British Steel Competition.

THERE is a general expectation that a further fall in steel prices covering joists, sections, &c., is imminent. It is understood that the British steelmakers will hold a meeting shortly for price revisions, and it is hoped that the adjustment likely to be made will effectually secure for the home trade this important branch of business. It is very well known that a great deal of constructional work is waiting to be given out, whenever price stability seems reasonably assured. The railways also have a lot of material to buy. Belgians are bidding strongly for this business, and are able to sell at £3 or £4 below the British quotation. Certain big steel contracts have of late been pending in connection with water schemes in India and on the Rand. These have served as a serious test of the international position. The statement that English interests have outbidden all competition in one of the biggest of these schemes has caused gratification. The report is that Dorman, Long and Co., of Middlesbrough, will supply the steel for a big pipe line order, running into many thousands of tons, and the report is happily confirmed. In some other directions, the steel trade is also adjusting itself to new conditions. Most of the Staffordshire steel re-rolling works are deriving their raw material from the Continent, some from Belgium, others from France and Luxemburg, and a certain proportion of the half products which our manufacturers are working up come from the other side of the new German frontier. Belgian steel sheet bars are coming here at £8 delivered, and billets are about the same price. But the British steel works are now making a determined effort to handle this competition, and as billet orders are locally accepted at as low as £8 10s., the foreign contribution, in the way of unfinished steel, should be a rapidly diminishing quantity. Home prices are now approximating more closely to those of the foreigner in certain cases, but except in classes of material in which quality is everything, the disordered exchanges give continental shippers an easy priority. Steel wire rods can be obtained from Germany at a little over £11, and though the British price has been brought down, the difference is still appreciable enough to deflect the course of business where British material is not specified.

The New Pig Iron Prices.

Not much is yet heard of the expected new reduced pig iron prices resulting from the reduction in coke. That they will have to be declared, however, is certain. Buyers will be satisfied with nothing short of a declared reduction. For the moment, the new make from Derbyshire furnaces which are being recommissioned is offered at 140s. for forge and 155s. for foundry on Birmingham exchange. Other sorts are nominally as follows:—South Staffordshire forge, 160s.; No. 3 foundry, 180s.; cold blast, 340s. to 347s. 6d.; Northampton forge, 137s. 6d. The pig iron industry has only taken advantage to a very small extent of the reduced coke prices. Now that the coke ovens are showing a real disposition to ease matters for the smelter, steps are being taken to rekindle a few furnaces which have their own outlets for a good deal of their production, and enjoy special advantages from their propinquity with the coke ovens. Certain of the Derbyshire furnaces are mentioned in this connection, among them the Stanton, Butterley, Denby, Renishaw and Staveley plants. Operations are being resumed tentatively. There is no intention of employing anything like the full resources of these organisations at present. There is very little prospect of Staffordshire furnaces entering into competition till coke becomes cheaper and the demand for iron and steel broadens considerably. Northamptonshire firms, likewise, regard blowing in as too risky an experiment as things are just now. Smelters who have decided to resume have already been made unpleasantly aware in their search for business of the fact that the Belgians are very strongly entrenched. Belgium is still sending iron into this district at an outside charge, including carriage, of £6 15s., underselling foundry irons of this district by over £1 per ton. It may be recalled here that seven years ago ordinary grades of native pig iron were selling round about 50s. Similar iron cannot be produced in the district to-day at less than thrice that price. Belgian competition in the regular descriptions of forge and foundry pig iron was even unheard of down to last year. To-day it has entire control of the market. There are, however, some advantages in buying at home which later on may outweigh with consumers even a considerable disparity of price. What, indeed, mainly exercises the minds of those smelters who have decided to try their luck again is the absorptive capacity of the market. Their overtures to Birmingham customers have not met with much encouragement so far, but the market is expected to throw off its present holiday lethargy in a little time. Importance is attached to the latest reports from America showing improved pig iron prices and a commencement of buying over the last half-year on a considerable scale.

Coke Prices Must Fall Further.

That hard coke prices must soon fall a further 5s. per ton and ultimately 10s. per ton, is the general conviction of the Midland and Staffordshire iron trade. To obtain a clear idea of what 30s. per ton for coke at the ovens, or 40s. at the furnaces, means to the iron trade, it is necessary to recall that before the war South Staffordshire smelters were getting a better article than now at 15s. The principal explanation is the high cost of carriage, which places the smelter in a far worse position than before the war. For Yorkshire coke he had to pay 12s. 6d. per ton railway carriage, in addition to wagon hire, while for Durham coke, the railway charge amounts to as much as 16s. Smelters still complain, moreover, that the deterioration which for various reasons took place in the quality of the coke during the war has never been repaired. With the lowered efficiency, more coke is required to get the output, and this fact involves an added expense.

Freight Charges.

Midland iron and steel masters are hoping, now that the railways have returned to private ownership, that the question of the revision of freight charges, which weigh so heavily upon them, will receive early attention. The decontrol of the railways is welcomed as putting an end to an administration which, however much could be said for it as a war measure, has been felt to be oppressive from the trade point of view. Although the different companies have already made various minor concessions, it looks as if the manufacturer will have to wait a long time yet for any real relief in the matter of freights. Railway carriage charges are felt very heavily by the iron and steel makers of the Midlands, who are hoping for a more sympathetic attitude towards the reasonable requirements of trade than has been shown during the *régime* just ended. The railway companies, it is said here, have now to justify themselves as "common carriers," and to show that under private management articles of merchandise can be carried as expeditiously and economically as under any other system.

Cheap Malleable Iron.

Malleable iron is cheap in Birmingham to-day. What matter that the material is Belgian? The stuff is to hand and contracts for manufactured goods can be filled and any profit pocketed. I speak from a consumer's standpoint. While our own mills state that orders taken for unmarked bars at less than £16 are unremunerative, nut and bolt manufacturers are being bombarded with offers of continental bars at £9 10s. The stagnation is such, however, that there is hardly any call for merchant iron bars, and consumers have every prospect of being able to fulfil their requirements should a demand spring up. The common iron trade at the present, indeed, is practically in a state of deadlock, the standard price being not only unprofitable, but failing to attract business. Stocks of finished iron in merchants' warehouses are becoming decidedly low, and where the local quality is insisted upon, it may be possible soon to come to terms, provided the collieries will make some concession in the price of works coal. Current demand shows only an insignificant improvement, but when firms which are just now getting out final valuations in connection with the winding up of the excess profits duty, have a more precise view of the position, the new policy will no doubt begin to shape itself. The makers of best Staffordshire iron bars present an agreeable contrast to their *confrères* in the unmarked department, the steady inflow of small orders keeping them fully engaged. Prices remain at £20 per ton. A few galvanised sheet firms have started in the Bilston district with fair order books and a reasonable hope of being able to continue. The inquiry for sheets has not developed as was anticipated. Prices continue easier at £22 10s. to £24 to £25 for galvanised doubles.

Ironworks Coal.

General complaint is still made of the very high price demanded for coal, some quotations exceeding £2 per ton. One Birmingham ironmaster was somewhat elated at being quoted 30s. per ton, representing a fall of about 5s. below the most favourable received for several months past. The coal position at the moment is easily the most peculiar in the long history of the trade. The supply of fuel far exceeds the demand, but instead of fostering a market, the coalowners are hanging out grimly for their price. There is a decided slump in the Cannock Chase coal industry. During the past week practically all the collieries have been working, on certain days, half or three-quarter time. There is a glut of coal. Railway sidings are packed with trucks already loaded, but the fuel cannot be disposed of at the high prices prevailing. A Cannock Chase coalowner this week said that a readjustment of the industrial position was only possible by means of big cuts in the price of works coal to enable them to compete in the open market with some prospect of success. He instanced the case of a firm in the Birmingham area which had incurred a loss of £3000 on a fortnight's working. The North Staffordshire Colliery Owners' Association has withdrawn the recent increase on the price of manufacturing coal, and has also reduced the price of slack by 1s. 6d. per ton. On the resumption of work after the coal stoppage, the owners advanced industrial coal by an average of 5s. At the end of July there was a reduction of 2s. 6d., so that with this new reduction of 2s. 6d. the increase is now entirely withdrawn.

Scrap.

While the price of iron and steel scrap continues low, there is hardly any disposition to sell, the holders preferring to retain it for steel-smelting requirements.

Midland Workless.

It is certainly a good sign that the latest unemployment returns for the West Midland area show fewer workless people. During the week ending August 12th, 3939 persons dropped off the live register of totally unemployed, while during the past month the number has decreased by no less than 51,070. There are now in this area 195,199 workers with nothing to do, of whom 79,104 belong to the shipbuilding, engineering, ironfounding and metal manufacturing trades, 31,325 who are ordinarily engaged in miscellaneous metal manufactures and 12,062 general labourers.

LANCASHIRE.

(*From our own Correspondents.*)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THE process of getting down working costs and prices in the iron and steel trades of the country goes on very slowly, and in fact one finds a difficulty in realising that it is going on at all. Nevertheless, some progress is being made, although one could wish that for the sake of the trade of Great Britain it could be expedited. For while we are gradually reducing prices our competitors for the trade of the world are making rapid strides and increasing every week the amount of world business which Great Britain will have to win back again; that is, if she is to regain her former position amongst the industrial nations.

Metals.

It is a rather curious fact that while we need most urgently a rapid fall in the cost of iron and steel, the fall which is now taking place is in the non-ferrous metals, which were already quite cheap enough. For nearly a year the prices of copper, tin, and spelter have not stood in the way of any expansion of business in the engineering industry, whereas the prices of iron and steel have been a very serious hindrance to this same expansion. Of course, one reason for the extreme weakness of copper is the hopeless prices for iron and steel. If we had a cheap supply of the latter we should be able to use a much larger quantity of the former, and probably if the truth were fully realised people would see that the only hope for British engineering is in a return to the state of affairs when Great Britain possessed the cheapest coal and iron in the world. The collapse of the copper market is certainly disconcerting, but it is not probable that the fall can go very far. Brass and copper tubes have been reduced by ¾d. per pound—£7 per ton—since I last wrote, and although this reduction does not make the prices correspond properly with the quotations for the raw metals, it is something to the good. There are some anomalies in these manufactured copper prices which might receive the attention of makers; as, for instance, a difference of 4d. per pound between locomotive tubes and condenser tubes, and a difference of £28 per ton between solid-drawn and brazed brass tubes; also a difference of £10 between strong copper sheets and flat bottoms. The market for refined copper is very poor, and best select ingot copper is still quoted at the same price as standard—a sure sign of the poverty of demand. Germany appears still to be the best European buyer of copper, and that is surely a good proof that Germany is moving more quickly towards recovery than other countries. Tin has again been a very depressed market, and people are now talking of £150 per ton as a settling level in place of £160. But it is impossible to say what may occur. There is a large quantity of tin in the East which has been held for £200 per ton, and if holders should become too tired to maintain their position anything may happen. There is no market now capable of withstanding the pressure of large sales; but, of course, this pressure might not come until the demand is better. There has been very little change in the position of lead and spelter, but the latter may be more plentiful when German metal begins to arrive again.

Pig Iron.

The market here for foundry iron is very much the same as it was, and there is practically no market for any other kind of pig iron. Forges are doing very little in the way of making finished iron, and the present prices stand in the way of any large selling. Hence they are not large buyers of forge pig; and as for basic pig, the prices quoted for foreign supplies are hopelessly below those possible for British furnaces. The demand for foundry iron seems now to be diminishing. The Derbyshire furnaces sell a little at £8 or perhaps in some cases a little less at the furnaces. This means £8 10s. or perhaps £8 7s. 6d. in Manchester. It may be possible occasionally to buy a little Cleveland iron on slightly easier terms; but the Cleveland sellers are trying to get the buyer of No. 3 to take a proportion of lower grades, and this is what the Manchester ironfounder does not like. Foreign pig iron is coming in at about £6, or in some cases less, but the market for it is rather disturbed because no one knows what, if any, action may be taken to hinder this business under the "Safeguarding of Industries" Act.

Finished Material.

The North-Eastern Section of the Steel Makers' Association has announced a reduction all round of £1 per ton on plates and sections. This makes the price of common steel plates £14 per ton and of steel boiler plates £20. The very unreasonable £6 difference between ship and boiler plate is thus maintained. Foreign steel plates are quoted at £8 5s. f.o.b., and sections at about the same price. Outside sellers of British steel are still quoting it £1 per ton below the new official list, and buyers as a rule are patiently waiting for the prices to come down to a more reasonable level. It may be, however, that, if steel makers here can get practical protection under the new Act, they may refuse to bring their prices down, and we shall have the spectacle of a small trade at high prices instead of a normal trade at competitive prices. There has been no change made yet in the official price of Lancashire bar iron, &c., although it is believed that some reduction is under consideration.

Scrap.

The market for scrap is practically dead. There may be an occasional small sale of foundry scrap at about £6 per ton, but the demand even for foundry scrap is very small, and there is no demand at all for steel or wrought iron scrap.

BARROW-IN-FURNESS, Thursday.

Hematites.

For a very considerable time consumers of iron have been pressing for a lower level of prices, but this has not been possible, for smelters have had to face the high cost of raw materials and labour. Since last week, however, a cut has been made in the price of mixed numbers of Bessemer iron to the extent of 10s. per ton: but as to how far this reduction will induce a run of new business is not at all certain. There are those who are of opinion that a drop of quite £2 will be necessary before a normal state of things can be reached, and anything like a big volume of business done in face of the keen competition from the Continent in certain sorts of metal. But coal and

coke prices are not falling to any extent, and much depends upon that. In the meantime there are three furnaces producing iron, one each at Ulverston, Cleator, and Millom. They are engaged on special orders for which delivery is urgently wanted. There are no signs yet of any resumption at Barrow.

Iron Ore.

At some of the mines in the Furness district and also in Cumberland part time is being worked to meet the demand for iron, but no general resumption can be looked for until more furnaces are put into operation. Miners' wages in Furness have been reduced by 1d. per shift, and the new rates are 13s. 2d. for bargains, with a minimum wage of 11s. 5d. per shift. This represents a reduction on the current year of 9s. 6d. per shift. These reductions are fixed by the selling price of iron.

Steel.

At Barrow, after being idle for a few weeks, the mills at the hoop works were again in operation on Monday, French billets being used on account of their low price. It would be impossible to carry on with local billets. Otherwise there is nothing new to report in the steel trade. The whole of the steel producing plant at Barrow and Workington remains idle.

Shipbuilding and Engineering.

The settlement of the joiners' strike will bring some activity to the Barrow Shipyard, where the woodwork of ships has been held up for months past, one big vessel, the Cunard liner Scythia, having had to be finished abroad. She has now been completed and on Saturday last sailed on her maiden trip across the western ocean from Liverpool. Work on the Cunarder Antonia, launched at Barrow some months ago, is held up. The oil tanker Scottish Standard, built by Vickers Limited for Tankers Limited, is fast approaching completion.

SHEFFIELD.

(From our own Correspondent.)

The Local Situation.

Acute depression still overhangs the local industries, and while one hears vague reports of improvement, many representative firms describe the last two weeks as the worst of the slump, the comparative cessation of buying having extended to all branches of steel products. While European competition is mainly responsible for the absence of overseas orders, that influence does not explain the unsatisfactory state of the home markets. German cutlery and tools are very much to the fore in British warehouses and shops, but importations from Germany have tended to decrease for a long time, and holders of stocks find it difficult to sell goods. Prices of steel commodities continue to be reduced, but buyers appear to expect further concessions and are acting accordingly. It is felt that stocks of many commodities must now be at the point of exhaustion. The greatest feeder to the local trades has always been the shipbuilding industry, and Sheffield is feeling the extreme slackness of that branch very acutely. The railways of the world are also doing very little for the city at present, although it is notorious that the British companies are badly needing more rolling stock and stores. For this reason it is believed that the giving out of large orders for the railways is only being deferred. The roll of unemployed continues as large as ever, while the number partially employed tends to increase. Most firms have more staff than they can find work for and are reducing them gradually. Every week sees the discharge of several men who have held responsible commercial positions at important works for many years. It is feared that more will have to go if things do not soon mend. The extreme financial stringency has induced large firms to adopt a considerate policy regarding the payment of accounts. Everybody seems to be in arrears, but so long as the debtors remit something on account occasionally creditors are abstaining from taking extreme measures to secure the balances. To attempt to enforce the prompt payment of large overdue accounts might have serious consequences all round.

Crucible Steel and Ferro-Alloys.

Makers of high-speed and other tool steels are unable to report any general evidence of revival, and melting operations are only intermittent. There are conflicting opinions as to prospects, some people being hopeful and others pessimistic. The market for ferro-alloys is completely stagnant. Low-carbon ferro-chrome has dropped 20s. per ton and ferro-silicon 10s. per ton. With the exception of chrome, ferro-alloy prices have fallen to round about the pre-war level.

Prices.

Derbyshire foundry iron has been offered as low as £7 15s. delivered to this district, which is, however, nearly 30s. higher than continental iron. There is keen competition for the limited trade done in soft basic billets, and the material can be bought at £11. Hematite mixed numbers are easier. Several classes of materials are procurable below official prices.

Fuels.

Good quality foundry coke is quoted at 65s. delivered to works, but no orders are being booked, except for lots equal to a few days' requirements. Little or nothing is being done in blast-furnace or crucible steel coke. The market continues in a depressed state for small fuels and house coals, with a little business being transacted in steam qualities.

Engineering.

The conditions of the engineering industry in the West Riding have experienced a constant decline of activity for some time past, and the trade at the moment is the reverse of healthy. Makers are having to meet the competition of firms possessing more plant than they want, and who are desirous of producing ready money by disposing of the surplus at half what it cost. Several new works which are being developed abroad have obtained a considerable proportion of the plant they want in this way. British firms have sold them mills, forging presses, furnaces, engines, and all sorts of machines and tools, all in excellent condition and some of them scarcely used. A number of the first-class rolling mills and presses is in hand at the local foundries, but as nothing new is being received to replace this work a quiet time in the near future seems inevitable. Makers of machine tools, textile machinery, steam and internal combustion engines have been busy in various export markets all the year, but so far as the West Riding is concerned the foundries are now badly off for work, with little or nothing certain in prospect.

Stainless Steel for Turbine Blades.

Several patents have been registered in Germany for new stainless steels. One of them is intended for machine parts which are subjected to high stresses, and which is said to have given satisfactory results in both laboratory and practical tests. It was particularly successful when applied to the blades of a steam turbine as a substitute for the nickel-steel alloys hitherto used for the purpose. According to German reports, the investigation of a test wheel fitted alternately with nickel steel and stainless steel blades proved the superiority of the latter in a striking manner. After three years' service the nickel steel blades were hopelessly corroded whilst the other blades had remained entirely intact.

Railway Transport in Eastern Europe.

The vital importance of efficient railway transport to the well-being and even the very existence of countries which are fairly developed economically and socially is vividly brought home in the report of the British Commercial Secretary at Bucharest. In this document he gives an extremely valuable survey of the breakdown of transport, which is crippling not only Rumania, but also her neighbours in Eastern Europe. Industrial establishments in those countries, he says, have been carried off by invading enemies or allowed to deteriorate owing to the lack of skilled men to repair it. The greatest single industry of all—transportation—has absolutely collapsed in Europe. During the war locomotives and trucks were used up to the last ounce of their capacity, repairs were skimped, and when the Armistice came masses of rolling stock had broken down or were near to breaking point. In many cases the point of danger had already been passed during the war, and had an attempt been made to operate the railways at anything like pre-war speeds and capacities, undoubtedly a series of terrible accidents would have ensued. Not only had the rolling stock been brought down to an extremely low pitch of efficiency, but the permanent ways also had been allowed to fall into a state approaching ruin on many lines not essential for military purposes, while even on these latter the pressure and violence of military operations had been such that a proper level of maintenance had not been kept up. In addition to the devastation caused by the war to the rolling stock and permanent ways of Europe, no less a deterioration has taken place in the ranks of skilled railway operators. Engineers were taken from their places and thrown into war-time duties regardless of the economic side of their activities, and those who were left were thrust back, morally and physically damaged, to take up their peace duties. The mechanics of the workshops and the ordinary railway workers were taken from their regular duties into the ranks of the army; their numbers were depleted by death and disease, and their pre-war skill deserted them. The intricate economic and political life of Europe was, it is now seen, dependent for its existence upon an elaborate system of transportation.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

The general situation in the Cleveland pig iron trade still leaves a good deal to be desired. It is gratifying to find working expenses falling, but manufacturers are still unable to drop quotations to anything like levels which will admit of successful competition with producers abroad, and at the moment cannot be described as otherwise than gloomy and discouraging. The fall in fuel prices, however, constitutes a hopeful factor. The entire absence of demand from the ironworks for fuel is fast bringing collieries to a standstill, and prices are coming down so rapidly that we may be within reasonable distance of a general resumption of work at the blast-furnaces. It is declared that 30s. per ton is the maximum price which the ironmaster can afford to pay for blast-furnace coke delivered at the works. That figure has not been reached yet, but it can be bought for 30s. at the ovens or about 35s. delivered, and it is possible that a firm offer of 30s. per ton delivered over a period of months would be accepted. Thus the outlook as regards costs of production are brightening, but this cannot be said of the demand. Prices are still too high to attract business, and there will have to be material reductions before any substantial business can be done. The extreme scarcity of No. 3 Cleveland pig iron keeps the price at 135s. per ton, which is 15s. above the official price, but No. 4 foundry has been dropped another 5s. per ton, and is now offered at 125s., but there are no buyers, and it is possible that even this figure would be shaded. No 4 forge and mottled iron are not in demand, and are vainly offered at 117s. 6d. per ton, whilst white iron commands no more than 115s. per ton. No export premiums are now demanded, but there is no foreign business, and, indeed, the arrival of another large cargo of basic iron in the Tees from Antwerp indicates that steel makers still find it more economical to obtain pig iron from abroad.

Hematite Pig Iron.

The production of East Coast hematite pig iron is increasing, but prices are firm, and there is less disposition to cut quotations for foreign orders. In some cases mixed numbers are quoted 160s., both for home and export, but other holders offer iron at 150s. for export, whilst adhering to the agreed price of 160s. for home deliveries.

Iron-making Materials.

The oreign ore trade is completely idle. Deliveries have ceased, every works having heavy stocks. Many consumers, however, have unexpired contracts to complete at high prices, and this, no doubt, acts as a deterrent to a resumption of work.

Manufactured Iron and Steel.

The present position of the manufactured iron and steel trade is causing a good deal of anxiety. Order books are gradually being worked off, and there is little new business coming forward. News that Dorman, Long and Co. have secured a big Indian contract for finished material has been received with satisfaction, but generally makers find themselves up against keen foreign competition. The expectations of a further price cut have been speedily realised, ship plates, angles, joists and sections all being reduced £1 per ton, whilst boiler plates are down £2 per ton. Lower prices will certainly help the shipbuilding industry, but the slump is so severe that shipbuilding orders are likely to show a further decline, and this must necessarily react upon the steel trade. Thus there is not much hope of a revival at present, and the most that can be looked for is that the price cuts will stimulate demand in other directions.

The Coal Trade.

The Northern coal market is quite unimproved, and the whole range of the trade is so dull and uninteresting, and so little actual business is possible that a feeling of despondency is more common than hopefulness. The position from a colliery owners' point of view is really very anxious and menacing, as in spite of their most strenuous endeavours to maintain a firmer front, the prices continue to slip away daily, while there is hardly anything being booked for forward deliveries, either for home or abroad. A waiting policy is being apparently pursued by all classes of consumers, who prefer to cover only their present actual needs, and await the market reaching the bottom, which, in the opinion of many, is a contingency still in the future. In the meantime, the position of some of the collieries is becoming desparate, and unless the cost of production can be cheapened, it looks as if more pits will have to be closed down. Most of the collieries are already faced with huge losses. The export trade is almost lifeless. Exporters report that a few inquiries more or less interesting have been in circulation, but so far nothing has come of them beyond the intimation that they have been postponed for the present. There are also several now under consideration which may possibly share the same fate. The Northumberland steam coal section has rarely experienced such a serious slump like the present one, and prices, which have consistently relaxed from day to day for some weeks past, have even further deflated, and as low as 27s. 6d. for bests has been offered, with correspondingly lower offers for seconds. The Durham section is also weak, but hardly to the same extent, and while second and third grades of gas coal, coking and bunkers can be done cheaply, the prime and special classes are able to make a better show of resistance than many of the Northumbrian sorts.

Twenty Thousand Miners Idle.

The slump in the coal trade is becoming increasingly severe, and the situation in the Northern coalfields is very serious indeed. Upwards of 20,000 miners are still out of work in Durham County, and the numbers are being increased practically every day; 106 collieries are either idle or working short time. Several of the pits have not been reopened since the stoppage, and amongst these are Sleetburn, the property of the New Brancepeth Coal Company; Allerdene, normally employing 600 men, and Ravensworth with 700 men, owned by the Birtley Iron Company; Byers Green, Thrislington, Sunnybrow, Tudhoe, Wooley and Auckland Park. Some others are expected to close down in the near future. West Thornley Colliery, which was idle before the stoppage, has not yet reopened. Very many collieries are only working short time, and at several, in addition to large numbers of unemployed, others are receiving notice. The most favourable reports come from the eastern part of the county, where most of the pits are working full time, but in the western area the outlook is gloomy. In the Northumberland coalfield the position is not so serious, but several pits are lying idle while numbers of others are working badly.

The Shipyard Joiners' Acceptance.

The acceptance on the part of the shipyard joiners of a reduction in wages has brought to an end a dispute in the shipbuilding industry which extended over a period of eight months, and in its later stages had a serious effect upon all endeavours towards an active restart in the shipyards following the prolonged coal strike. The settlement of this dispute has been received with a deep feeling of thankfulness, inasmuch as it clears the atmosphere of the only outstanding industrial disturbance in Northern industry. The effect of the settlement upon Tees-side and in the Hartlepools will not be so marked as in the shipbuilding areas on the Tyne, for most of the work in the first-named areas during the dispute was either done by the apprentices or the ships were sent abroad to be finished. On the Tyne and Wear, however, some of the yards have as much as two years' work in hand for the returning joiners.

An Important Experiment.

The visit of the Right Hon. W. F. Massey, Prime

Minister of New Zealand, to Darlington last Saturday was not without commercial interest. New Zealand has some rich deposits of sand and ore, and if the tests now being carried out prove successful, it is more than probable that it will become a great ore-exporting country. Accompanied by Mr. R. B. Summerson, the works officials, and Professor Harbord, Mr. Massey visited Messrs. Summerson's works, and witnessed the tapping of molten metal from the electric smelting furnaces. The metal was manufactured from New Zealand iron sand, and Professor Harbord had been deputed by the New Zealand Government to prepare an official report of the experiment.

SCOTLAND.

(*From our own Correspondent.*)

Increasing Imports.

Markets generally remain in a most uncertain position, and the outlook is still rather obscure. For a time the situation appeared to improve. Fuel was, and is, cheapening and wages were tending downward. Also there appeared to be a lull in imports of competitive material, with a hardening of prices. Now, however, foreign imports are reported to be on the increase and quotations still remain pounds per ton below home prices. Steel makers have taken another £1 off their prices, but a few more similar reductions will be necessary. Ironmakers have decided to make no more at present, though, of course, any day might bring a change in policy. Everyone seems to be determined to wait until the bottom is knocked out of the coal market and fuel reduced to as near pre-war values as possible before starting operations on a big scale. That contingency seems a long way off, however. Already the lack of orders has caused certain collieries to slow down and also to contemplate closing until the market recovers or wages become lower. A slight movement in the pig iron trade is one of the few bright features. Generally speaking, however, markets remain dull in the extreme, and producers are merely hanging on until something turns up to improve matters.

Joiners' Settlement.

The end of the joiners' strike has come none too soon. Much business has been lost, to say nothing of the work which has been retarded or sent abroad for completion. The settlement of this strike is a hopeful sign, and with costs falling the outlook at the shipyards has improved. An improvement here would soon affect local steel and ironworks, where the lack of shipyard orders has been very severely felt. The foreigner, of course, would come in here too; but home works would always receive a share.

Pig Iron.

The position of pig iron shows a turn for the better. Some makers are nearing the producing stage and other furnaces are being re-lit. Although business is meagre, makers evidently wish to be ready for eventualities. Home stocks are very low and could not stand a big call. Foundry iron is particularly scarce. Occasional orders still come on the market and have to be supplied from stock. Prices are likely to be reduced considerably, but no move is anticipated until production is well on the way.

Finished Steel and Iron.

The conditions governing the steel and iron trades are very difficult. Fuel is cheapening, but other costs remain high. Continental materials are again flowing into the market, and makers are confronted with prices which they cannot hope to touch. Another reduction has been made in steel, but the drop will have to be a big one and not just a paring now and then. A fair inquiry for steel sheets for export is reported, but the price difficulty is a strong barrier. Until this discrepancy between home and competitive prices is rectified local works cannot export more than pickings. Bar ironmakers stand firm meantime, even though current business is of a negligible quantity. Foreign bar iron is selling round about £7 15s. to £8 per ton, against the quotation of £16 for home production. The engineering trade is also very dull at present.

Coal.

Business in the coal trade is extremely disappointing. Outputs are fair and prices considerably reduced, but buyers are very inactive. Industrial demands are small and only immediate wants are negotiated for. House coal also is quiet. A little is being done in export, but the market is merely moving and nothing more. The collieries are becoming flooded with stocks and many are in danger of being closed down again. Quite a number have adopted a working policy of three days per week in order to prolong employment, but this cannot last long at the present rate of buying. Aggregate shipments for the week amounted to 147,281 tons, against 154,652 in the preceding week and 341,211 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Coal Export Operations.

The easing down of foreign coal export orders is becoming more apparent in its effect upon the market, which is quiet. How long the period of slackness is likely to be, it is difficult to say, but that such conditions prevail is no surprise, and was not unexpected. In normal times, September, October and November were the months when contracting operations over the following year were carried through, and these operations were invariably preceded by bearing tactics. Buyers designedly held off for the purpose of depressing the market in the full expectation that the most might be made of it to arrange their requirements over the next twelve months at the lowest possible figure. This year the conditions are exceptional, as, quite apart from long-period operations, buyers generally consider that the market, even for prompt orders, has not settled down to a real working basis, and that prices are too high; further, that such prices must come down as output increases and competition for the more limited requirements of consumers abroad generally develops. American coal competition is regarded as practically eliminated, but South Wales has a much more formidable competitor in North Country coals, which are reported to be offered abroad at figures so low that buyers hold the view that South Wales coals must come down in price to conform to their relative value. Costs of production, however, in South Wales are relatively high, and although wages in the coalfield next month will be down, it remains to be seen to what extent such fall can enable market prices to relax. The question whether coalowners can or will cut their prices, will be answered shortly, but if report now current has any truth in it, the indications are that colliery owners cannot see their way at present to lower their prices appreciably without risk of reaching an unremunerative level. The report is that next week will see wholesale stoppages in the coalfield. This may be an exaggeration, but it is highly probable that work at many collieries will be of an intermittent character, owing to the lack of orders, and the consequent difficulty in securing the release of wagons. The secretary of the South Wales Coalowners' Association has recently dealt with the question of prices and costs of production, and he states that it must not be assumed that prices will fall to the pre-war level. Such an eventuality is impossible under present conditions. Since 1914 the labour cost of getting coal has permanently increased, as the result of many concessions to the workmen, but more especially in consequence of the reduction in the working hours from eight to seven per day. This is a serious and permanent factor in bringing about an increased cost. The price of practically all materials has doubled, and in many cases more than doubled. For example, the price of pitwood, of which about 1¼ million tons are used per annum, in South Wales was about 18s. per ton in 1913 as against a price about 40s. per ton at present. Railway and dock charges show an increase of about 160 per cent. above pre-war, the cost of taking coal from the pit to the dock including shipment charges, having risen from about 2s. per ton to from 5s. 6d. to 6s. per ton.

French Coal Imports.

Mr. R. M. Stewart, the secretary of the British Coal Exporters' Association, has lately sent a letter to the secretary of the South Wales Coal Exporters' Association, dealing with the question of French coal prices, and he says he has been in communication with M. Ader, late Controller of Coal in France and now of the office of the Minister of Public Works. M. Ader says it is owing to erroneous information in the English Press that the impression has arisen that when the Bureau National des Charbons ceased its operations, the French Government would no longer interfere in questions affecting the importation of coal. He says that the Law which permits of the fixing of prices for imported coal is, in fact, applicable to the end of this year, and it is not yet certain whether Parliament will prolong it or not. That will depend in particular on the position of English exports, the artificial *régime* of which has been a very onerous one for France for a long time. M. Ader inquires whether English exporters who still have contracts with France at excessive prices will accept either the cancellation of those contracts or have them adjusted to the current prices ruling at the date of delivery. He depends upon the Federation of Coal Exporters' Association to assist France to get back to the *régime* of commercial freedom to which they in France aspire as ardently as exporters do here.

Competition Foreshadowed.

The announcement of the registration of the United Spanish Coal Company of Great Britain, Limited, discloses the formation of a very interesting and formidable combination. The capital of this new company is £100,000 in £1 shares, but the strength of its backing will be appreciated when it is stated that the firms associated with the new enterprise comprise Messrs. Blandy Brothers and Co., Hamilton and Co. (Teneriffe), Hull, Blyth and Co., Lambert Brothers, Limited, the Atlantic Coaling Company, Limited, Wilson, Sons and Co., Limited, Cory Brothers and Co., Limited, Millers and Corys, Cape Verde Islands, Limited, and Mann, George and Co., Limited. The object of the promoters is no secret, as it is pretty well known that it is intended to stiffen the competition with the combination represented by the Anglo-Spanish Coaling Company, Limited, the Canary Islands Coal and Oil Company, Limited, L. Gueret, Limited, and D. R. Llewellyn, Merrett and Price, Limited. The Anglo-Spanish Coaling Company, Limited, originally promoted by the late Lord Rhondda, owns a chain of coaling stations on the Spanish coast, and in conjunction with the other associated companies, has in the past year extended its operations to Las Palmas, Teneriffe. It certainly looks as if the competition between them is going to be keen.

Craftsmen's Union.

The enginemen, stokers and craftsmen in the South Wales coalfield, who have resolved upon resuscitating their old association and re-establishing their independence, have decided to adopt the title of the South Wales and Monmouthshire Technical and Surface Workers' Union. Already the membership numbers 7000 with 57 branches, this number being an increase of 2000 members in about a week. The Forest of Dean technical staffs have applied to be included in the new union.

Current Business.

The coal market is in a very sluggish condition, and comparatively little business is passing. Best Admiralty large are quoted at 35s., but might possibly be secured at a shade under that figure, while second qualities can be obtained at 32s. 6d. Monmouthshire large rule about 30s. to 31s., while steam smalls of superior quality are quoted at 17s. 6d. to 20s. Patent fuel is rather quiet at 35s. and coke at 60s., while pitwood is easier at 37s. 6d. to 40s. Anthracite coals continue fairly steady and in good demand. Anthracite large ranges from 55s. to 60s., with cobbles at 57s. 6d. to 65s., nuts 70s., peas 42s. 6d. to 45s., rubbly culm 20s. to 22s. 6d., breaker duff 12s. 6d., and billy duff 7s. 6d. to 8s. 6d.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

The New Cut in Steel.

The official cut this week of a further £2 per ton in steel boiler plates on the North-East Coast, and of £1 per ton in ship and tank plates, and also in sections, is very welcome to consumers the country over. The announcement shows that the meeting of steel producers to consider the question of prices, which in my letter this week I have described as imminent, has already taken place. The drop leaves boiler plates at £19, common plates at £14, and angles and joists at £13 10s. A somewhat improved demand is reported at date from some of the centres for steel plates and sections, and the drop should help on matters.

Remarkable Wages Advance.

It reads remarkably at the moment to hear of wages advances. Yet such a thing is this week going on in Birmingham. The operative brassworkers are receiving an immediate increase of ½d. per hour under the new sliding scale recently agreed upon between the masters and workmen forming a National Wages Board for the regulation of future wages and the prevention of disputes. The sliding scale is based on the Government cost-of-living figures, and this week's advance follows upon an increase of three points in the Government returns, the increase being from 119 points to 122 points. This new Birmingham arrangement affords a hint to some other trades perhaps as to how future labour troubles may be avoided.

SHEFFIELD.

Rustless Iron.

Considerable and important developments are reported of the new alloy known as "stainless iron," and being softer and more easily worked up than stainless steel, it has far greater possibilities of application. Several local and one or two outside firms are manufacturing it in the electric furnace, and it is being used for a number of finished goods, such as golf clubs, cooking utensils, motor car bonnets and fittings, fireplaces, fenders, shop signs and door plates. There is believed to be a wide field for the material for motor car bodies as a substitute for aluminium, as it is less expensive and more durable. It should also replace electro-plated parts and brass fittings for houses, railway carriages and many other articles. It is more expensive than brass, but users would probably regard the saving of labour of cleaning as well worth the extra cost. Stainless iron is actually more expensive to produce than stainless steel, because it requires in the composition from 10 to 12 per cent. carbon-free ferro-chrome, which is a highly costly alloy. A local firm has acquired the rights in a patented process for making carbon-free ferro-chrome much more cheaply than can be done at present.

WALES AND ADJOINING COUNTIES.

Ebbw Vale Works.

The iron and steel plant at the Ebbw Vale Works is to be restarted as soon as practicable, and the fitting shops and other departments are preparing for a resumption. No. 4 mill and the Siemens furnaces are to commence immediately, and will be followed quickly by the Victoria blast-furnaces, by-product plant, &c., while the steel works proper will, it is expected, be ready for restarting early in October. The works have been idle for several months, and workmen in many instances have been unemployed since last October.

Ironworks Restarting.

The new Margam Ironworks of Baldwins, Limited, are to commence operations shortly. It is reported that this company has obtained an order for 17,000 tons of rails, which will give employment to several hundred workmen for some months.

Market.

The coal market continues easy, and prices look like being down to close on 30s. for superior large steams by the end of the week. There has been a sharp break in pitwood this week, owing to scarcity of wagons, and prices have fallen from 40s. to 30s.

American Shipbuilding.—The American Bureau of Shipping recently reported that there were eighty-two steel ocean-going cargo vessels, of 621,917 gross tons, under construction in American shipyards on August 1st. The amount of tonnage being built has shown a steady shrinkage during the past month, inasmuch as seven new vessels were completed and delivered to the Shipping Board. There is considerable activity in the smaller craft, and there were eighty-two vessels, of 44,453 gross tons, classified as river and harbour boats, in the shipyards on August 1st. Only fifteen more steamers—passenger liners, tankers and cargo carriers—remain to be delivered to the Shipping Board before the immense Government building programme comes to an end. During July three 13,000-ton passenger ships were delivered, three tankers were accepted by the Shipping Board and one 11,000-ton cargo carrier was added to the Government-owned merchant fleet. Two new ships were launched, one a passenger liner and the other a 10,000-ton tanker.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	—
[1] Spanish	28/-
[1] N. African	30/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	37/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—[2]		
Hematite	9 0 0	—
No. 1 Foundry	8 15 0	—
No. 3 ,,	8 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	8 0 0	7 10 0
No. 1	8 2 6	7 12 6
Cleveland—		
No. 1	—	—
Silicious Iron	—	—
No. 3 G.M.B.	6 15 0	6 15 0
No. 4 Foundry	6 5 0	6 5 0
No. 4 Forge	5 17 6	5 17 6
Mottled	5 17 6	5 17 6
White	5 15 0	5 15 0
Midlands.		
Staffs. *(Nominal).*—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	7 0 0	
,, Foundry No. 3	8 5 0 to 8 15 0	
Northampton [3] *(Nominal).*—		
Foundry Nos. 2 and 1	8 2 6	
,, No. 3	7 12 6 to 7 15 0	
,, Forge	6 17 6	
Derbyshire [3] *(All nominal).*—		
No. 3 Foundry	7 17 6 to 8 0 0	
Forge	7 0 0	
Lincolnshire [3]—		
Basic	*Uncertain.*	
Foundry	,,	
Forge	,,	
N.W. Coast—[4]		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	8 5 0	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
N.E. Coast—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Tees	14 10 0	—
Lancs.—		
Crown Bars	16 0 0	—
Hoops	20 5 0	20 0 0
S. Yorks.—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Hoops	20 5 0	—
Midlands—		
Marked Bars (Staffs.)	20 0 0	—
Crown Bars	16 0 0	—
Nut and Bolt Bars	16 0 0	—
Black Sheets (dbls. nom.)	17 10 0 to 18 0 0	
Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal)	22 10 0 to 24 0 0	
Gas Tube Strip	20 0 0	—

STEEL.

	Home.[6] £ s. d.	Export.[7] £ s. d.
Scotland—[5]		
Boiler Plates	19 0 0	—
Ship Plates $\frac{3}{8}$in. and up	14 0 0	—
Sections	13 10 0	—
Steel Sheets $\frac{7}{16}$in. to $\frac{3}{8}$in.	16 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	24 0 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	14 0 0	14 0 0
Angles	13 10 0	13 10 0
Boiler Plates	19 0 0	19 0 0
Joists	13 10 0	13 10 0
Heavy Rails	14 0 0	—
Fish-plates	19 0 0	—
Channels	14 10 0	—
Hard Billets	13 0 0	—
Soft Billets	11 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	14 0 0	—
Light ,,	17 0 0 to 19 0 0	
Billets	13 0 0	—
Ship Plates	14 0 0	—
Boiler ,,	20 0 0	—
Manchester (*Prices irregular and uncertain, unchanged*)—		
[8] Bars (Round)	13 0 0 to 14 0 0	
[8] ,, (others)	14 0 0 to 15 0 0	
Hoops (Best)	20 5 0	20 0 0
,, (Soft Steel)	17 5 0	17 0 0
Plates	14 0 0	—
,, (Lancs. Boiler)	20 0 0	—
Sheffield (*Prices irregular and uncertain*)—		
Siemens Acid Billets	16 0 0	—
Bessemer Billets	15 10 0	—
Hard Basic	13 0 0	—
Soft ,,	11 0 0	—
Hoops	17 5 0	—
Soft Wire Rods	13 15 0	—
Midlands—		
Small Rolled Bars	12 10 0 to 14 10 0	
Bessemer Billets and Sheet Bars	8 10 0	—
[2] Hoops	17 0 0	—
Tube Strip	12 10 0 to 13 10 0	
Angles and Joists	13 10 0	—
Tees	14 10 0	—
Bridge and Tank Plates	14 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	22/6 to 24/6
Block Tin (cash)	152 2 6
,, (three months)	153 15 0
Copper (cash)	68 0 0
,, (three months)	66 15 0
Spanish Lead (cash)	23 0 0
,, (three months)	22 10 0
Spelter (cash)	24 10 0
,, (three months)	25 0 0
Manchester—	
[9] Copper, Best Selected Ingots	68 0 0
[9] ,, Electrolytic	71 10 0
[10] ,, Strong Sheets	103 0 0
,, Loco Tubes	0 1 $2\frac{3}{4}$
Brass Loco Tubes	0 1 $0\frac{3}{4}$
,, Condenser	0 1 $4\frac{1}{2}$
Lead, English	24 5 0
,, Foreign	23 0 0

(*Metal prices practically unchanged*).

FERRO ALLOYS.

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/6 to 1/8 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£36	12/-
,, 6 p.c. to 8 p.c. ,,	£34	12/-
,, 8 p.c. to 10 p.c. ,,	£34	12/-
,, Specially Refined		
Max. 2 p.c. carbon	£79	28/-
,, 1 p.c. ,,	£94	32/-
,, 0·75 p.c. carbon	£110	41/-
,, carbon free	2/8 per lb.	
Metallic Chromium	5/6 per lb.	
Ferro Manganese (per ton)	£18 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	22/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/6 per lb.	
Nickel (per ton)	£190	
Cobalt	15/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official).	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	27/- to 27/6
,, ,, Ell	31/6
,, ,, Splint	28/6 to 32/6
,, ,, Trebles	29/-
,, ,, Doubles	27/6
,, ,, Singles	25/-
Ayrshire—	
(f.o.b. Ports)—Steam	27/-
,, ,, Splint	28/6
,, ,, Trebles	29/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	26/- to 28/-
Screened Navigation	32/6
Trebles	28/-
Doubles	26/-
Singles	24/-
Lothians—	
(f.o.b. Leith)—Best Steam	27/-
Secondary Steam	25/-
Trebles	29/-
Doubles	27/-
Singles	25/-

ENGLAND.

	Export.
[11] N.W. Coast—	
Steams	44/-
Household	56/8 to 60/-
Coke	—
Northumberland—	
Best Steams	27/6 to 30/-
Second Steams	26/- to 27/-
Steam Smalls	13/- to 15/-
Unscreened	22/6 to 27/-
Household	30/- to 35/-
Durham—	
Best Gas	30/- to 32/6
Second	26/- to 27/6
Household	30/- to 35/-
Foundry Coke	45/- to 55/-
Sheffield—[12]	
S. Yorks. Best Steam Hards	33/2 to 33/8
Derbyshire Hards	32/8 to 33/2
Seconds	31/8 to 32/2
Cobbles	31/8 to 32/2
Nuts	31/2 to 32/2
Washed Smalls	28/8 to 30/2
Best Hard Slacks	20/- to 25/-
Seconds ,,	20/- to 23/-
Soft Nutty ,,	20/- to 25/-
Pea ,,	18/- to 22/-
Small ,,	15/- to 18/-
House, Branch	40/2 to 40/8
,, Best Silkstone	36/8 to 37/2
Blast Furnace Coke	(45/-, 55/- export)

SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	34/- to 35/-
Second ,, ,,	33/- to 34/-
Best Dry Large	34/6 to 35/6
Ordinary Dry Large	32/6 to 33/6
Best Black Vein Large	32/6 to 33/6
Western Valley ,,	32/6 to 33/6
Best Eastern Valley Large	32/6 to 33/6
Ordinary ,, ,,	30/- to 32/6
Best Steam Smalls	18/6 to 19/6
Ordinary ,,	12/6 to 17/6
Washed Nuts	36/6 to 38/6
No. 3 Rhondda Large	45/- to 47/6
,, ,, Smalls	27/6 to 32/6
No. 2 ,, Large	30/- to 32/6
,, ,, Through	22/6 to 25/-
,, ,, Smalls	16/6 to 17/6
Coke (export)	60/- to 62/6
Patent Fuel	32/6 to 35/-
Pitwood (ex ship)	27/6 to 30/-
Swansea—	
Anthracite Coals:	
Best Large	55/- to 57/6
Seconds	55/- to 57/6
Red Vein	40/- to 45/-
Big Vein	55/- to 57/6
Machine-made Cobbles	70/- to 72/6
Nuts	72/6 to 75/-
Beans	60/- to 65/-
Peas	42/6 to 45/-
Breaker Duff	12/6 to 15/-
Rubbly Culm	20/- to 22/6
Steam Coals:	
Large	37/6 to 38/6
Seconds	36/- to 37/-
Smalls	15/- to 17/6
Cargo Through	26/- to 29/-

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Delivered Sheffield. [5] Glasgow, Lanarkshire and Ayrshire.
[6] Home Prices—All delivered Glasgow Station. [7] Export Prices—F.O.B. Glasgow. [8] Prices represent the real market before the *official* change was made.
[9] These prices are practically alike now. [10] Sheets reduced while other prices are advancing. [11] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. [12] For inland sales. [13] Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

A Tariff War.

THE fact of France being the first to impose graduated tariffs against countries with a depreciated currency does not prevent her from complaining of similar treatment from Great Britain. While the general tariff, as applied particularly to Germany, has been increased to 300 per cent. above the minimum tariff, it has been raised to such an extent that, for many classes of manufactured goods, Britain and other countries profiting from the minimum tariff are unable to do business in France at all. The tariffs serve the double purpose of protecting home industries and of providing means of extorting concessions abroad in favour of French products. They are avowedly a part of foreign policy which other nations have been obliged to adopt in self-defence, with the result that Europe has embarked upon a tariff war which must inevitably prevent a revival of international trade unless something is done to attenuate its effects. In putting up duties to a much higher level than is justified by the difference in money values, France had in view the possibility of entering into commercial arrangements with other countries that would be to her advantage. The result was that Belgium, always a Free Trade country, found itself obliged to impose heavy import duties, and now that Great Britain has adopted a new and more rigorous fiscal measure, the French find that the advantages of the new policy, if any exist, are not all on their side. As the Anti-dumping Bill provides means of imposing serious restrictions on imports from France, it is probable that the French will hasten the carrying out of negotiations for the adoption of "commercial arrangements," whereby it may be possible to establish a working basis for international trade by means of mutual concessions. While no doubt a satisfactory solution will be come to eventually, it is, nevertheless, curious that so much ingenuity should be displayed to stifle trade at a time when the general interest lies in according every facility for foreign exchanges.

Wages.

The conditions that formerly justified a considerable advance in wages having been modified in the direction of a much lower cost of living and by the necessity of bringing down manufacturing costs if the works and factories are to be kept running at all, there has been a general scaling down of rates, first by the suppression of the indemnity for high living cost and then by a reduction in wages. In the majority of cases the men have accepted the lower rates. They had no alternative in view of the certainty of a large number of works being obliged to close down unless it were possible to realise appreciable economies in production. In the Nord, however, the men's unions have been organising a general resistance to any reduction in wages, with the result that the strike movement which started some time ago in the textile industries has been rapidly extending. In one or two cases the trouble has been settled by the men accepting one half of the original reduction of 10 per cent., but it is clear that the fight will continue for some time to come, since employers cannot possibly bear the burden of wages that, allowing for the difference in money values, are generally 50 per cent. higher than those paid before the war, while they have to pay at the same time considerably increased taxation and overhead charges. Such burdens cannot be borne on a falling market, and the present struggle must end in the men consenting to make some sacrifice.

A Pumping Scheme.

The cost of unwatering the iron ore mines in the Briey basin increases as the extraction becomes more active, and the amount paid by the companies for pumping operations is so heavy that they are specially interested in a proposal whereby, it is claimed, the cost will be reduced by about six million francs a year. At present the water is raised to the surface at elevations of from 60 m. to 185 m. above the level of the river Moselle. A mining engineer, M. Hanra, has made a close study of the local geological formation, and finds that it will be possible to connect up all the galleries so that the water raised from the lower levels will drain into a sump and thence by a gallery into the Moselle. The total length of the galleries will be about 50 kiloms., and the dimensions will increase gradually to a maximum width and height of 2 m. Arrangements are being made with a company to carry out the work.

New Street Paving.

About a year ago some tests were carried out on one of the thoroughfares in Lyons, in which the traffic is particularly heavy, with a new system of road construction introduced by the Fonderies de Pont-à-Mousson, and the results obtained as regards absence of wear and maintenance costs have been since confirmed by experiments in other towns. Further experimental sections of road are to be laid down for some of the railway companies, as well as in Paris. The construction consists in the laying of a foundation of ordinary concrete in which are embedded hollow square blocks of cast iron. The spaces between the blocks and the hollows are filled up with a finer concrete to make a smooth surface. The number of blocks per square metre and the direction in which they are placed depend upon the nature of the traffic. They are arranged in such a way as to prevent the skidding of vehicles, and as the hollow square blocks are close enough together to carry the load without its coming on the concrete there is no uneven wear, while the different characters of the material employed render the surface non-slipping. It is claimed that the cost is very much below that of wood, granite or asphalt, and that while the cost of maintenance is negligible, the surface must have a far greater durability than is possible with any other system of construction. Another advantage claimed is the practically unlimited supply of cast iron blocks which can always be obtained in any quantities.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

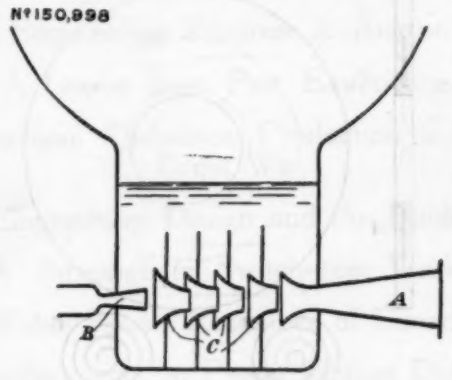
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date o application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

150,998. September 2nd, 1919.—IMPROVEMENTS IN EJECTOR DEVICES FOR WITHDRAWING CONDENSATE FROM A CONDENSER, Metropolitan-Vickers Electrical Company, Limited, of 4, Central-buildings, Westminster.

One of the main objects of this invention is to produce an improved ejector which is self-starting and is capable of efficiently entraining and discharging relatively hot condensate from a condenser. The nozzle B extends through one side of the hot well, and is adapted to discharge fluid such as steam at a high velocity into and through four cones. A diffuser A with the

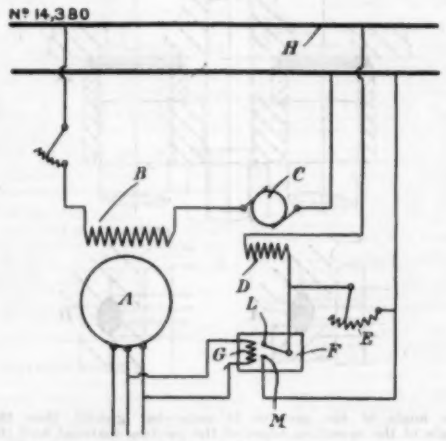


usual combining cone at its inlet end is axially aligned with the nozzle B and the intermediate cones. The cones C are mounted in diaphragms, which divide the hot well into compartments. In operation, motive fluid, such as steam, is discharged at high velocity through the nozzle B and into the cones C. Condensate is entrained by the jet of motive fluid, and is carried by it into and through the cones and diffuser A. The ejector is capable of operating with a hotter condensate than is possible with an ordinary ejector.—*July 21st*, 1921.

DYNAMOS AND MOTORS.

14,380. June 15th, 1914.—IMPROVEMENTS IN OR RELATING TO THE REGULATION OF ALTERNATING OR THREE-PHASE CURRENT GENERATORS, Voigt and Haeffner Aktiengesellschaft, of Hanauerlandstrasse, 152–158, Frankfurt-a-M., Germany.

This invention relates to a regulating system for plants in which large exciter units are employed to supply a varying exciting current to an alternating current generator and at the same time operate auxiliary devices such as oil switches without varying the voltage of the exciter. The source of exciting current H for the field B of the generator A may supply a number of similar systems. The field winding B of the generator and the exciting machine C are connected in series with the mains supplying the field current. The shunt winding D of the

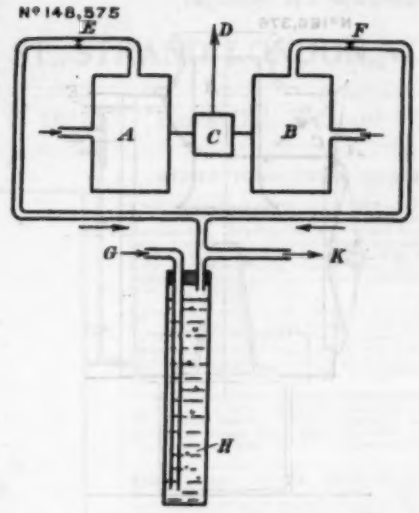


exciter C is connected across the main H and is normally in circuit with the resistance E. The terminals of the resistance E are connected to the contacts L and M of the vibrator E, and when the contacts are closed the resistance E is short-circuited. The contacts L and M are controlled by the coil G, which is connected across the mains of the generator A. Thus, when the E.M.F. of the generator rises above a predetermined maximum the coil G causes the contacts L and M to make contact and so short-circuit the resistance E. This increases the current in the winding D of the existing machine C and thereby increases the opposing current passing through the winding B, thereby reducing the E.M.F. of the generator A.—*June 15th*, 1914.

MEASURING AND TESTING INSTRUMENTS.

148,575. July 6th, 1914.—A METHOD OF AND APPARATUS FOR THE CONTINUOUS DETERMINATION OF THE SPECIFIC GRAVITY OF GASES, Doctor Leo Ubbelohde, of Bismarckstrasse 41, Karlsruhe, Germany.

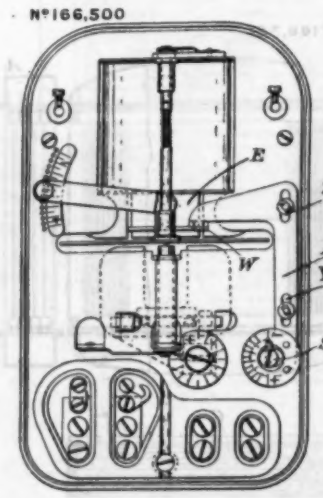
In the drawing A and B are gas meters and C a differential gear which registers any difference in the working of the meters by means of a recording device D. E and F are nozzles. The apparatus H is for maintaining a constant pressure difference relative to the atmosphere. Air enters the pipe G. A pump is connected to the pipe K, and the suction of this pump causes air bubbles to pass continuously through the liquid in the tube H. The gas to be tested is sucked in at A and goes to K. A standard gas such as air is sucked in through the meter B and also goes to K. The pressure difference on the two sides of the nozzles E and F is equal to the pressure difference in the appa-



ratus relatively to the atmosphere, but the quantity of gas or air which passes the nozzle under this pressure difference at E and F is dependent upon the specific gravity of the gas or air. Any variation of this specific gravity of the gas therefore alters the consumption of the meter A, whilst the consumption of the meter B is not varied since it deals with air.—*January 21st*, 1921.

166,500. July 18th, 1921.—IMPROVEMENTS RELATING TO ALTERNATING CURRENT ELECTRICITY METERS, S. Z. De Ferranti, and Ferranti, Limited, all of Hollinwood, Lancaster.

This specification describes a method of adjusting integrating meters, indicating instruments and relays. A copper stamping W is fixed to a cranked slide piece X, and the stamping surrounds the lower portion of the shunt magnet coils E. The cranked slide is provided with slots Y engaging pins Z fitted to the meter casing, compression springs being carried on these

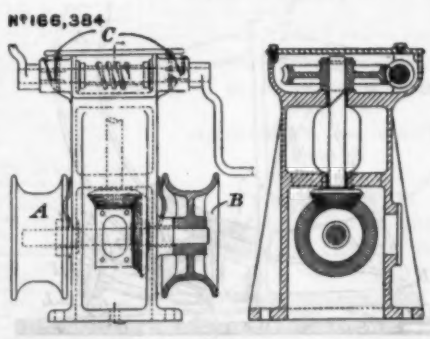


pins and adapted to press the slide firmly against surfaces on the casing. Upon turning the screw S in one direction the slide is lifted and the cranked end carrying the copper stamping W is moved upwards in relation to the shunt winding E and the speed of the meter is increased. Movement of the screw in the opposite direction produces the reverse effect.—*July 18th*, 1921.

LIFTING GEAR.

166,384. July 21st, 1921.—IMPROVEMENTS RELATING TO WINCHES, Harland and Wolff, Limited, of Queen's Island, Belfast, and James Donaldson Stewart, of 11, Bathgate-drive, Standtown, Belfast.

This specification describes a combined winch and bollard having two drums A and B and means are provided for rotating the drums and for locking them against rotation. By rotating the drums by means of the handle, weights may be raised or

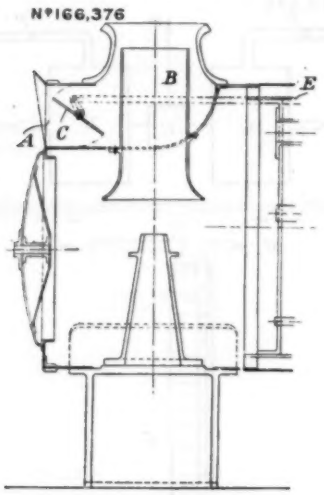


lowered or cable under tension can be hauled in or paid out, whilst when the drums are locked they can be used as bollards around which cable may be paid out or made fast. When the drums are used as bollards pins are inserted at C.—*July 21st*, 1921.

LOCOMOTIVES.

166,376. April 28th, 1920.—Apparatus for Draught Inducing on Locomotives and the Like, William Scott, Hazel House, Whickham, Swalwell, Durham.

The smoke passes through the uptake pipe B from the boiler

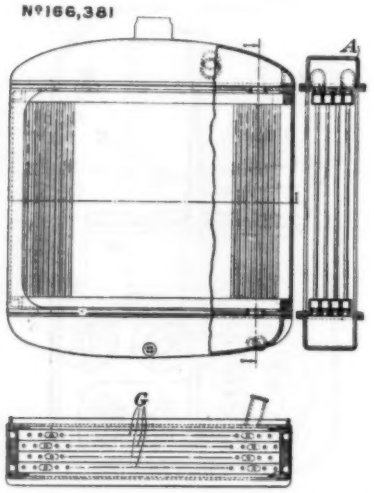


furnace to the chimney. C is a damper which is operated by the rod E. A wire gauze screen is placed in the mouth of the duct A to prevent objects entering the air channel. When the locomotive is in motion the draught enters the mouth of the duct A and it can be regulated by the damper.—*July 21st*, 1921.

MOTOR CARS AND ROAD TRAFFIC.

166,381. April 30th, 1920.—Improvements in and relating to Radiators for Motor Vehicles and the Like, Eric George Morley, of Guy Motors, Limited, Fulling's Park, Wolverhampton.

The radiating elements are formed as a plurality of detachable sections or units arranged one behind the other in planes parallel with the front of the radiator. When it is desired to clean the radiator or to replace a damaged part, it is only necessary to undo the frame bolts, and the upper header A can then be lifted off and the sections G removed. Each section can then be

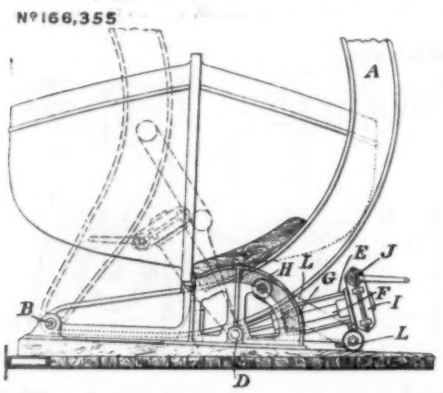


separately dealt with, and is easily cleaned and replaced. Should one section of the radiator be damaged, that section may be removed and a new section substituted without disturbing the remaining sections. For roadside repairs, a damaged section may be removed and a plate with packing may be placed over the corresponding openings in the headers so that the radiator may still be used with the remaining sections.—*July 21st*, 1921.

SHIPS AND BOATS.

166,355. April 14th, 1920.—Improved Means for Luffing Ships' Davits, Axel Wellin, of Hopetoun House, Lloyd's-avenue, London, E.C. 3.

For operating the davit a frame is pivoted about the axis

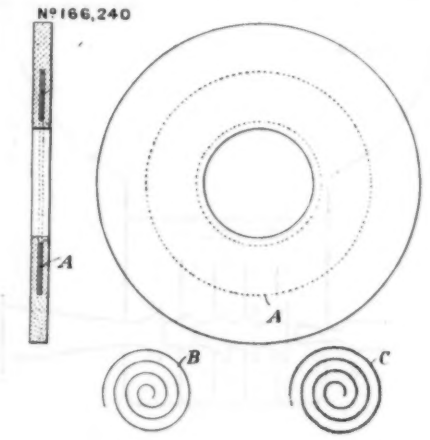


of a toothed quadrant made fast to the deck. A is the davit arm which is pivoted on a fore and aft axis B and supports a boat. To a fore and aft axis D a shaft F is journalled, and carries a bevel pinion G meshing with a quadrantal rack H secured to the deck. On the shaft there is also a worm wheel contained in a casing I, and this wheel meshes with a worm carried on a spindle J to which a handle can be fitted, so that the spindle G can be caused to travel round the quadrant H. The frame is connected by a link L to the davit. In the inboard position the frame E lies close down to the deck and the link L crosses the axis of the shaft F at a small angle. As the handle K is rotated the link thrusts the davit out until finally the frame, having passed the vertical, is inclined towards the edge of the deck and the link is practically parallel to the axis of the shaft as shown in dotted lines.—*July 14th*, 1921.

MISCELLANEOUS.

166,240. January 10th, 1921.—Improvements in or relating to Friction Rings or Discs for Friction Clutches, Herbert Frood, of Sovereign Mills, Chapel-en-le-Frith, Derby.

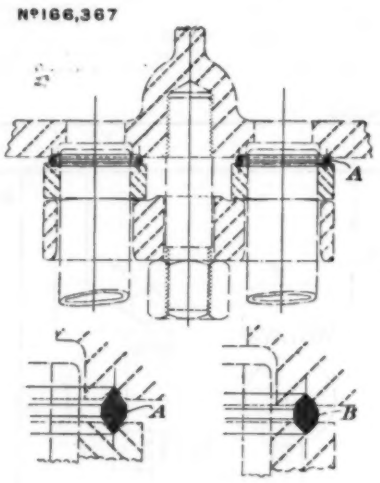
The friction disc or ring constructed in accordance with this invention has incorporated or embedded in it a reinforcing ring, disc or coil of metal, wire, ebonite or other suitable material. In the case of discs composed of a mass of unwoven fibres the reinforcement is embedded whilst the disc is moulded; whilst in the case of a disc which is built up of laminations of unwoven



or woven fibres or fibrous material, the reinforcing rings, discs or coils may be interposed between the laminations. The invention has for its object to provide means of strengthening or reinforcing the friction rings or discs circumferentially. The reinforcement is in the form of a flat ring as shown at A. When wire is used for the reinforcement it may be coiled in a spiral, as shown at B, and the wire may be straight or zigzagged, as shown at C.—*July 11th*, 1921.

166,367. July 21st, 1921.—Improvements in and relating to Jointing Washers, Sir Henry Fowler, of Derwent House, Milford, Derbyshire, and William Gorman, of 43, Leacroft-road, Derby.

The joint is made by compressing a jointing ring or washer of copper or equivalent material and of lozenge cross section between the opposed surfaces of the joint, and these surfaces are formed with angular grooves to receive the jointing ring A. The essentially novel feature of the invention is that in a joint of this character using a jointing ring of lozenge section,



the angle of the grooves is somewhat greater than the angle of the operating edges of the jointing material, and the gaps between the ring and the walls of the grooves are filled more or less completely by deformation of the ring, as shown at B, when external pressure is applied to the joint. The upper drawing shows the joint applied to a superheater header.—*July 21st*, 1921.

Trade Possibilities in the Union of South Africa.—Mr. W. G. Wickham, his Majesty's Senior Trade Commissioner in South Africa, is at present in this country on an official visit and is prepared to interview at the Department of Overseas Trade from September 1st to September 16th firms who desire to obtain information as to trade possibilities in the Union of South Africa. Mr. Wickham will be pleased to meet manufacturers and merchants who may wish to consult him with regard to steps to be taken for opening up trade, and among the matters on which he is prepared to give information and advice are the general state of trade in South Africa, method of marketing and distributing of goods, terms of payment, rates of customs duties, and general information as to openings existing for British goods. London firms which are desirous of consulting Mr. Wickham should communicate with the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, quoting the reference 3092/T.G. and indicating briefly the subject on which the interview is desired. Mr. Wickham will subsequently visit some of the principal industrial centres of the United Kingdom.

Forthcoming Engagements.

MONDAY TO SATURDAY, SEPTEMBER 5TH TO 10TH.

Iron and Steel Institute.—Autumn meeting in France.

WEDNESDAY TO WEDNESDAY, SEPTEMBER 7TH TO 14TH.

British Association.—Annual meeting in Edinburgh. For programme see page 154.

FRIDAY, SEPTEMBER 9TH.

The Institution of Locomotive Engineers (London).—By invitation of Mr. Geo. Hughes, C.B.E., chief mechanical engineer, Lancashire and Yorkshire Railway, the members of this Institution will visit the Clifton Power-house, at Clifton Junction. Special train leaving No. 1 platform, Manchester (Victoria) Station, at 2 p.m. prompt.

MONDAY, SEPTEMBER 12TH.

The Institution of Locomotive Engineers (London) Leeds Centre.—Visit to the locomotive works of Sir W. G. Armstrong, Whitworth and Co., Newcastle. Meet at the main entrance of the locomotive works at 2 p.m.

WEDNESDAY, THURSDAY AND FRIDAY, SEPTEMBER 21ST, 22ND, AND 23RD.

The Institute of Metals.—Autumn meeting in Birmingham. For programme see page 151.

SATURDAY, OCTOBER 8TH.

Association of Engineers-in-Charge.—Holborn Restaurant, London. Twenty-first annual dinner. 6 p.m.

EDUCATIONAL INTELLIGENCE.

The following appointments have been made in the Faculty of Engineering at University of London, University College:—Mr. M. T. M. Ormsby—previously Reader in Surveying—to be Chadwick Professor in Municipal Engineering; Mr. Bernard H. Knight, to be Assistant in Municipal Engineering; and Mr. H. T. Davidge, to be Senior Lecturer in Civil and Mechanical Engineering.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

David Colville and Sons, Limited, have transferred their head office from Motherwell to 195, West George-street, Glasgow. Telephone number, 9280 Central; telegraphic address, "Colvillett, Glasgow."

Bucyrus Company, of South Milwaukee, Wisconsin, U.S.A., which was formerly represented in the British Isles by Messrs. G. F. West and Co., announces that it has now opened its own office at 19, Iddesleigh House, Caxton-street, Westminster, and requests that henceforth all communications for it should be so addressed.

LAUNCHES AND TRIAL TRIPS.

Conde de Churruca; built by Sir W. G. Armstrong, Whitworth and Co., Limited, to the order of Cia Generale de Tabacos de Filipinas; dimensions, 370ft. by 48ft. 3in. by 30ft. Engines, Armstrong Sulzer Diesel engines, pressure 120 lb.; constructed by the builders; trial trip, Saturday, July 16th.

Caennaise; steel screw collier; built by the Blyth Shipbuilding and Dry Dock Company, Limited, to the order of M. Fernand Bouet, of Caen; dimensions, 285ft. by 42ft. Engines, triple-expansion, 22in., 36in. and 60in., by 39in. stroke; constructed by the North-Eastern Marine Engineering Company, Limited; trial trip, Tuesday, August 9th.

Maypole; built by Henry Scarr, Limited, to the order of Palmine, Limited; dimensions, 122ft. by 24ft. by 8ft. 6in.; to carry 150 tons deadweight. Engines, twin screw direct-acting surface-condensing, 7in., 12½in. and 20in. by 12in. stroke, pressure 180 lb.; constructed by the builders; for service on the river Gambia and coastal trips between Bathurst and Daker; trial trip, Wednesday, August 10th.

Streefkerk; built by Rotterdam Drydock Company, to the order of Phs. van Ommeren-Rotterdam; dimensions, 421ft. by 55ft. 3in. by 31ft. 6in.; to carry 9300 tons deadweight. Engines, vertical triple-expansion of 2700 indicated horse-power, 26½in., 43in. and 73in. by 48in. stroke, pressure 180 lb.; Howden's forced draught system fitted; constructed by the builders; launch, Saturday, August 13th.

Baradine; built by Harland and Wolff, Limited, to the order of Peninsular and Oriental Steam Navigation Company, for Branch Line Service between London and Australia; dimensions, 537ft. by 64ft. by 41ft.; 13,300 gross tonnage. Engines, two sets of quadruple expansion, pressure 215 lb. per square inch working under forced draught; accommodation for 500 cabin passengers and 1000 third-class passengers; trial trip, Thursday, August 18th.

Bellbro, steel screw collier; built by Blyth Shipbuilding and Dry Docks Company, Limited; dimensions, 285ft. by 42ft. Engines, triple-expansion, 22in., 36in. and 60in. by 39in. stroke; constructed by North-Eastern Marine Engineering Company, Limited; launch, Thursday, August 18th.

Meriones, steel screw passenger and cargo steamer; built by Palmer's Shipbuilding and Iron Company, Limited, to the order of the Ocean Steamship Company, Limited; dimensions, 476ft. 6in. by 58ft. by 35ft. 3in.; to carry 10,000 tons deadweight. Engines, single screw double reduction geared turbines, pressure 220 lb.; constructed by the builders; Howden's forced draught fitted; launch, Friday, August 19th.

"Archibald Dawnay" Scholarships in Civil Engineering.—The late Sir Archibald Dawnay bequeathed a sum of money to the London County Council for the provision of scholarships tenable in civil engineering courses, and regulations have now been drawn up for the award of the scholarships. One scholarship will be awarded each year to candidates between sixteen and eighteen years of age who have passed or are exempt from the matriculation examination of the University of London. The scholarships will be tenable for two, or in some cases three, years in the course in civil engineering in the Battersea Polytechnic, Northampton Polytechnic, or the Finsbury Technical College. Additional institutions at which the scholarships may be held may be approved in future. The maintenance grant provided will be £110 a year, and out of it the scholar will have to pay his tuition fees, &c. Candidates will be required to comply with the Council's general scholarship regulations with regard to residence, nationality, &c. The first award will be made early in the autumn term, 1921. Application forms (T. 2/274) may be obtained from the Education Officer, New County Hall, S.E. 1, and must be returned to these offices on or before September 24th, 1921.